PERIODICAL
GENERAL LIBRARY
UNIV. OF

APR 31 1930

NATURAL HISTORY

March-April
1930

Price Fifty
Cents

THE CALL TO THE FEAST

JOURNAL OF THE AMERICAN
MUSEUM OF NATURAL HISTORY
NEW YORK, N. Y.

THE AMERICAN MUSEUM OF NATURAL HISTORY

Scientific Staff for 1930

HENRY FAIRFIELD OSBORN, LL.D., President
GEORGE H. SHERWOOD, ED.D., Director and Executive Secretary
JAMES L. CLARK, Assistant Director, Preparation
WAYNE M. FAUNCE, SC.B., Assistant to the Director and Assistant Secretary

I. DIVISION OF MINERALOGY, GEOLOGY, GEOGRAPHY, AND ASTRONOMY

HENRY FAIRFIELD OSBORN, LL.D., D.Sc., Curator-in-Chief

Astronomy

CLYDE FISHER, PH.D., LL.D., Curator

Minerals and Gems

HERBERT P. WHITLOCK, C.E., Curator
GEORGE F. KUNZ, PH.D., Research Associate in Gems

History of the Earth

HENRY FAIRFIELD OSBORN, LL.D., D.Sc., Honorary Curator-in-Chief
CHILDS FRICK, B.S., Honoray Curator of late Tertiary and Quaternary Mammals

Fossil Vertebrates

WALTER GRANGER, Curator of Fossil Mammals
BARNUM BROWN, A.B., Curator of Fossil Reptiles
GEORGE G. SIMPSON, PH.D., Associate Curator of Vertebrate Palæontology
CHARLES C. MOOK, PH.D., Associate Curator of Geology and Palæontology
WILLIAM K. GREGORY, PH.D., Research Associate in Palæontology
WALTER W. HOLMES, Field Associate in Palæontology

Geology and Fossil Invertebrates

CHESTER A. REEDS, PH.D., Curator

II. DIVISION OF ZOÖLOGY, AND ZOÖGEOGRAPHY

FRANK MICHLER CHAPMAN, SC.D., N.A.S., Curator-in-Chief

Marine Life

ROY WALDO MINER, PH.D., SC.D., Curator
WILLARD G. VAN NAME, PH.D., Associate Curator
FRANK J. MYERS, B.A., Research Associate in Rotifera
HORACE W. STUNKARD, PH.D., Research Associate in Parasitology
A. L. TREADWELL, PH.D., Research Associate in Annulata

Insect Life

FRANK E. LUTZ, PH.D., Curator
A. J. MUTCHLER, Associate Curator of Coleoptera
C. H. CURRAN, M.A., Assistant Curator
FRANK E. WATSON, B.S., Staff Assistant in Lepidoptera
WILLIAM M. WHEELER, PH.D., Research Associate in Social Insects
CHARLES W. LENG, B.S., Research Associate in Coleoptera
HERBERT F. SCHWARZ, A.M., Research Associate in Hymenoptera

Fishes

WILLIAM K. GREGORY, PH.D., Curator
JOHN T. NICHOLS, A.B., Curator of Recent Fishes
E. W. GUDGER, PH.D., Bibliographer and Associate
FRANCESCA R. LAMONTE, A.B., Assistant Curator
CHARLES H. TOWNSEND, SC.D., Research Associate
C. M. BREDER, JR., Research Associate
VAN CAMPEN HEILNER, M.Sc., Field Representative
LOUIS HUSSAKOF, PH.D., Research Associate in Devonian Fishes

Amphibians and Reptiles, and Experimental Biology

G. KINGSLEY NOBLE, PH.D., Curator
CLIFFORD H. POPE, B.A., Assistant Curator
CHARLES E. BURT, M.S., Assistant Curator
BERTRAM G. SMITH, PH.D., Research Associate
WILLIAM DOUGLAS BURDEN, A.M., Research Associate
FRANK S. MATHEWS, M.D., Research Associate
HOMER W. SMITH, SC.D., Research Associate
O. M. HELFF, PH.D., Research Associate

Birds

FRANK M. CHAPMAN, SC.D., Curator-in-Chief
ROBERT CUSHMAN MURPHY, D.Sc., Curator of Oceanic Birds
JAMES P. CHAPIN, PH.D., Associate Curator of Birds of the Eastern Hemisphere
ELSIE M. B. NAUMBURG, Research Associate

Mammals of the World

H. E. ANTHONY, M.A., Curator
ROBERT T. HATT, A.M., Assistant Curator
GEORGE G. GOODWIN, Assistant Curator
WILLIAM J. MORDEN, PH.B., Field Associate

Comparative and Human Anatomy

WILLIAM K. GREGORY, PH.D., Curator
H. C. RAVEN, Associate Curator
S. H. CHUBB, Associate Curator
MARCELLE ROIGNEAU, Staff Assistant
J. HOWARD MCGREGOR, PH.D., Research Associate in Human Anatomy
DUDLEY J. MORTON, M.D., Research Associate

III. DIVISION OF ANTHROPOLOGY

CLARK WISSLER, PH.D., LL.D., Curator-in-Chief

Science of Man

CLARK WISSLER, PH.D., LL.D., Curator-in-Chief
N. C. NELSON, M.L., Curator of Prehistoric Archæology
GEORGE C. VAILLANT, PH.D., Associate Curator of Mexican Archæology
HARRY L. SHAPIRO, PH.D., Assistant Curator of Physical Anthropology
MARGARET MEAD, PH.D., Assistant Curator of Ethnology

Science of Man (continued)

RONALD L. OLSON, PH.D., Assistant Curator of South American Archæology
WILLIAM K. GREGORY, PH.D., Associate in Physical Anthropology
CLARENCE L. HAY, A.M., Research Associate in Mexican and Central American Archæology
MILO HELLMAN, D.D.S., Research Associate in Physical Anthropology
GEORGE E. BREWER, M.D., Research Associate in Somatic Anthropology

IV. DIVISION OF ASIATIC EXPLORATION AND RESEARCH

ROY CHAPMAN ANDREWS, SC.D., Curator-in-Chief
WALTER GRANGER, Curator in Palæontology
CHARLES P. BERKEY, PH.D., [Columbia University], Research Associate in Geology
AMADEUS W. GRABAU, S.D., [Geological Survey of China], Research Associate

V. DIVISION OF EDUCATION AND PUBLICATION

GEORGE H. SHERWOOD, ED.D., Curator-in-Chief

Library and Publications

IDA RICHARDSON HOOD, A.B., Acting Curator
HAZEL GAY, Assistant Librarian
JANNETTE MAY LUCAS, B.S., Assistant Librarian—Osborn Library

Education and Public Health

GEORGE H. SHERWOOD, ED.D., Curator-in-Chief
CLYDE FISHER, PH.D., LL.D., Curator of Visual Instruction
GRACE FISHER RAMSEY, Associate Curator
WILLIAM H. CARR, Assistant Curator
NANCY TRUE, A.B., Staff Assistant
ELIZABETH A. ECKELS, PH.B., Staff Assistant
PAUL B. MANN, A.M., Associate in Education
FRANK E. LUTZ, PH.D., Research Associate in Outdoor Education

---

CHARLES-EDWARD AMORY WINSLOW, D.P.H., Honorary Curator of Public Health

---

Printing and Publishing

HAWTHORNE DANIEL, Curator, Editor of *Natural History*
A. KATHERINE BERGER, Associate Editor of *Natural History*
ETHEL J. TIMONIER, Associate Editor of Scientific Publications

Public Information

GEORGE N. PINDAR, Chairman
GEORGE H. SHERWOOD, A.M., ED.D.
WILLIAM K. GREGORY, PH.D.
WAYNE M. FAUNCE, SC.B.
CLARK WISSLER, PH.D.
HAWTHORNE DANIEL

Advisory Committee on Natural History Magazine

HAWTHORNE DANIEL, Chairman

HENRY FAIRFIELD OSBORN, LL.D., D. Sc.
CLARK WISSLER, PH.D., LL.D.
GEORGE N. PINDAR
FRANK M. CHAPMAN, SC.D.
FRANK E. LUTZ, PH.D.
GEORGE H. SHERWOOD, ED.D., *ex-officio*

A. KATHERINE BERGER

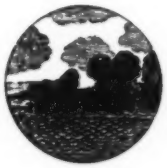
VOLUME XXX
NUMBER 2

NATURAL HISTORY

MARCH-APRIL
1930

The Journal of The American Museum of Natural History

HAWTHORNE DANIEL
Editor



A. KATHERINE BERGER
Associate Editor

CONTENTS

THE CALL TO THE FEAST ..... *Cover*
From a Painting by Arthur A. Jansson (See Page 233)

ENTRANCE AND EXIT TO CAÑON DEL MUERTO ..... *Frontispiece*

MELANESIAN MIDDLEMEN ..... Margaret Mead 115
The Trading People of the Admiralty Islands

LAND EROSION ..... Chester A. Reeds 131
How the Surface of the Earth Is Being Worn Away

THE ASTRONOMER'S WORKSHOP ..... Clyde Fisher 150
Instruments Man Has Invented for His Study of the Skies

IN QUEST OF THE QUEEN OF SHEBA'S ANTELOPE
Gertrude Sanford and Sidney LeGendre 161
Part II. The Home of the Antelope Is Finally Located and Specimens Are Secured

THE UPLAND PLOVER ..... Alfred M. Bailey 177
How this Game Bird Has Adapted Itself to Changed Conditions

WHALE SHARK! ..... L. L. Mowbray and E. W. Gudger 182
The Capture of a Specimen of the Greatest of Living Sharks

KING ALBERT INAUGURATES THE PARC NATIONAL ALBERT
Mary L. Jobe Akeley 193
Half a Million Acres Set Apart for the Preservation of African Wild Life

KARAMOJO—ONE OF AFRICA'S ODD CORNERS ..... George F. Shearwood 196
An Area Inhabited by a Tribe Unaffected by the White Man's Customs and Ideas

THE SOCIAL WEAVER BIRD OF SOUTH AFRICA ..... Herbert Friedmann 205
A Remarkable Bird Architect which Constructs "Apartment House" Nests

AMERICAN MUSEUM EXPEDITIONS AND NOTES 213

Published bimonthly by The American Museum of Natural History, New York, N. Y. Subscription price $3.00 a year.

Subscriptions should be addressed to James H. Perkins, Treasurer, American Museum of Natural History, 77th St. and Central Park West, New York City.

NATURAL HISTORY *is sent to all members of the American Museum as one of the privileges of membership.*

Entered as second-class matter April 3, 1919, at the Post Office at New York, New York, under the Act of August 24, 1912.

Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 15, 1918.

Copyright, 1930, by The American Museum of Natural History, New York.

© *E. J. Curtis*

ENTRANCE AND EXIT TO CAÑON DEL MUERTO, ARIZONA

This elongated box cañon, twenty miles long, affords an intermittent stream, which has eroded a channel bounded by walls eight hundred feet high, from which project enormous pinnacles, buttresses, and towers of light-red, cross-bedded de Chelly sandstone. In niches eroded in the cañon wall stand nineteen ruins, which were built 1060–1284 A.D. by an ancient race that has held the attention of explorers and archæologists since their discovery by J. H. Simpson in 1850.

See "Land Erosion" Page 131

VOLUME XXX

NATURAL HISTORY

NUMBER TWO

MARCH-APRIL, 1930

MELANESIAN MIDDLEMEN

A Description of the Trading People of the Admiralty Islands Who Have Built Up an Elaborate System of Primitive Markets and Who Make Long Overseas Trading Voyages in Their Slender Out-rigger Canoes.

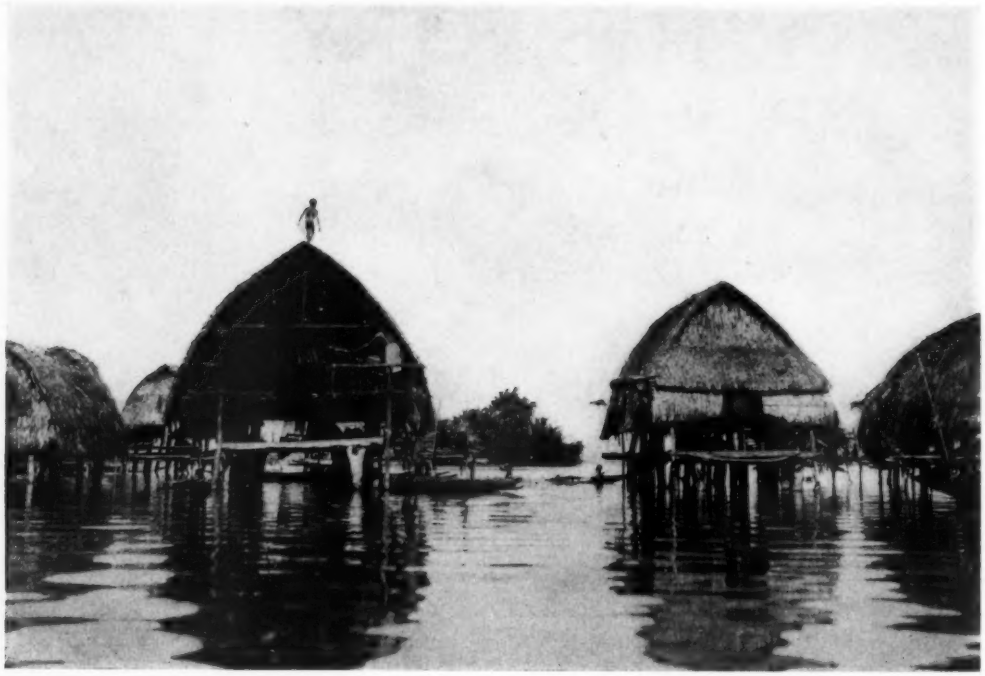
By MARGARET MEAD

Assistant Curator of Ethnology, American Museum

Results of Field Work Done in 1928–29 as a Fellow of the Social Science Research Council

TWO days' voyage from the Bismarck Archipelago lie the Admiralty Islands, an archipelago formed of one large island sixty miles long and a cluster of smaller ones, some of them fifty miles from the Great Admiralty, but none out of sight of its mountain peaks. The Great Admiralty is steep and mountainous; its red volcanic soil makes poor gardening and worse traveling. After a rain the surface of the island turns to mud; the thin, emaciated land people splash about from one small settlement to another, muddy and miserable. The inhabitants of the Great Admiralty are called collectively the Usiai—a word meaning "inland" in the sea people's tongue. They are divided into many small groups whose languages are relatively unintelligible to one another, and their customs differ considerably one from another. They are united by a common agricultural way of life and a common hatred of the more aggressive sea people, who in turn despise them. Timid, underfed, often bandy-legged, fearful of the sea, the general contempt in which they are held seems to give them a certain awkwardness of aspect,—the uncertainty and clumsiness of gesture which so often characterize the lighter-skinned, smaller-bodied "man-o-bush" in Melanesia. The poor soil and steep slopes make subsistence difficult, and the Usiai live in very small scattered communities of ten people and five dogs, only coming together for ceremonial occasions. Yet in these infrequent ceremonies is found more rank and style than in the festivities of the scornful sea people.

On the small islands, and in a few settlements on peninsulas and along the coast where there is firm land instead of the more frequent quaggy ring of mangrove swamps, live the peoples who are known as Matankor, the "eye of the land." Here, again, the sea people have classified together a number of groups of people speaking different languages and having different customs. To the sea people they all present the common characteristics of living on the land but



"BONNETING" THE ROOF OF A NEW HOUSE
The small boy is merely playing, for children do no important work in Manus. They are expert, however, at climbing house roofs and palm trees

near enough to the sea to know something of fishing, venturing upon the sea without giving to others shameful and ludicrous signs of fear. These Matankor groups are sometimes spread over half a dozen villages, on one or more islands; occasionally an offshoot of a village on the south of the archipelago will be found far to the north, speaking the same language and presenting the same cultural picture.

The Usiai and the Matankor are by far the most numerous peoples. Yet the archipelago is best known, is named from, and takes its color from a group of some two thousand people, who boldly proclaim themselves "Manus true," or "the soda water [salt-water] boys." Darker, heavier, firmer of purpose, the "Manus true" have no real hold upon the land of the Admiralties. Their stout pile dwellings are clustered like long-legged birds in the wide lagoons along one part of the south coast of the Great Admiralty, and in the shelter of a few precipitous islands. Their only lanes are bits of volcanic outcrop from the reef or small platforms laboriously constructed from coral rubble. On these barren bits of soil there is only a handful of greenery, a few trees from which the children pick fruit for spinning tops, a few bushes which flaunt the cerise hibiscus. The Manus village is a preserve staked out in water—its streets are waterways, its unoccupied house sites, or once inhabited suburbs marked only by a few rotting stakes against which the unwary paddler barks his canoe.

Viewed materially, these sea people are helpless denizens of the muddy lagoons, without lands or forests, without gardens, without fresh water, without wood to build their canoes and

houses, without sago leaves to thatch their houses. They have not the fiber for making fish nets, the clay for making pots, nor the bark for making mats and carrying bags. They belong to a race to whom the stimulus of betel chewing is almost more necessary than food itself, but they have neither betel trees, nor pepper plants, the leaves of which are chewed with the betel.

Of their need, of their complete dependence, they have built up a system of trade which is so efficient, so far spread in its ramifications, that they have made themseves the richest, the most dominant people in the southern part of the archipelago. (For the North I cannot speak, for I have not been there in person.) It is words from their language which creep into the lingua franca of the territory; the other peoples use Manus words to describe themselves.

The Manus have one industry—fishing—at which they are particularly adept. They know how to count the phases of the moon and predict the huge run of spawning fish into the lagoon. Here several canoes of beaters drive the fish into a half circle of two-man nets. Sometimes a thousand large fish are taken at a catch. Torch-light fishing and many types of weirs and baskets are also in continuous use. Their skill in fishing is the basis of their hold over the miserable, poorly nourished bush people. For fish and shell fish, the Usiai trade them sago, taro, taro leaf greens, fibrous bark for thread and rope making, betel nut, pepper leaves, bags, leaves for mats, gourd lime containers, gum for caulking their canoes; dishes, oil containers and funnels of basket work smeared with gum; sago leaf thatch. For turtles, or special large supplies of fish, they receive

A CANOE OF COCONUTS FROM RAMBUTCHON

These coconuts will be arranged in piles on the small islets, and will be used for a feast which will end a widow's ten months' mourning period

SCARIFIED IN THE FASHION OF THE MATANKOR
This Mok girl bears on her chest an elaborate representation of the lizard, which has been raised by rubbing open cuts with lime

wood for house building and for the construction of their large canoes. All the necessities of life are based upon this daily interchange which goes on between bush people and sea people. Regular markets are held to which the Manus men repair early in the morning with their canoes heavy from the chilly night's arduous fishing. The market places are held at different points along the shore to give different groups a chance to bring their wares. In the old days, a lattice work was built across a stream, and silent bargaining between men armed to the teeth was concluded by floating taro downstream and flinging the purchasing fish upstream.

The procedure is varied a little for different Manus groups. The people whose houses cluster in the shadow of the distant island of Buke depend upon their pots for their trade with the land people, and fish principally for their own purposes. Twice a week broad-beamed canoes laden to the gunwales leave the island which, away on the northern horizon, looks little bigger than the clam shell from which it took its name, and make their way up the narrow tortuous rivers into the Usiai country. Scowling, hating this journey into the hostile, sorcery-ridden interior, seeing lurking demons in the tangled swamps, voracious mythical snakes in the stagnant waters, vaguely connecting the fevers which overtake them in their safe salt-water village with the evils of the mainland (where mosquitoes abound), the Manus boatmen punt their freighted canoes up the stream, where they exchange their pots with a silent, hostile people.

The Manus people who live under the lee of the island of Mok, and speak with a soft dialect which the Manus of the great island lagoon comprehend but ridicule good-humoredly, are more fortunate. Their daily traffic is not with the furtive hostile Usiai, whose eye is ever on driving a sharp bargain, whose trade manners are atrocious, and workmanship poor. Instead, the Mok people trade with two Matankor groups, on the

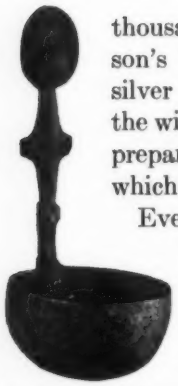
islands of Balowan and Lou. They are wont to boast of their Balowan customers, of their beauty, their good nature and trustfulness,—while the Usiai demand immediate payment, the Balowan man will trust one a good three days. From Balowan they obtain yams—"mammies"—their staple carbohydrate food, betel nut, pepper leaves, and beautiful wood work, carved bowls, carved ladles, delicately wrought betel spatulas. From Lou come obsidian glass for knives, carving tools, and spear heads, painted gum oil containers, carved dancing poles, decorated lime gourds, more wood work, and most of the fish nets used by the Manus people. From Lou and Balowan and the further island of Rambutchon, where a colony of Manus natives dwell near the Matankor colonies of the land, come the coconuts and coconut oil used by the entire group.

Within the tribe wealth changes hands most frequently in the ceremonial payments between families. Beginning with the betrothal in early childhood, there is a periodic exchange of valuables between the family of the bride and the family of the groom. The groom's kin give shell money and dogs' teeth which the bride's kin repay in various types of foods—many of which must be obtained from other tribes.

At betrothal, puberty, ear piercing, marriage, birth—these payments are made in the form of great festival displays. The dates of the feasts are announced several weeks in advance by a system of signals on the slit gong. When the set rhythmical prelude resounds through the village, people stop their work, children pause in their play to wait for the count. The prelude ceases, a single beat is given, the listeners count "one." A formal spacing tattoo follows, then another isolated beat. The listeners count "two," and so on up to ten or twenty or thirty. Thus the whole community is informed that Nane or Paleao or Talikai plans to give away many

MANUS MAN WEARING THE WAR CHARMS MADE BY THE PEOPLE OF PAK

When a man is slow in going into battle, the charm scratches his back and urges him to bravery



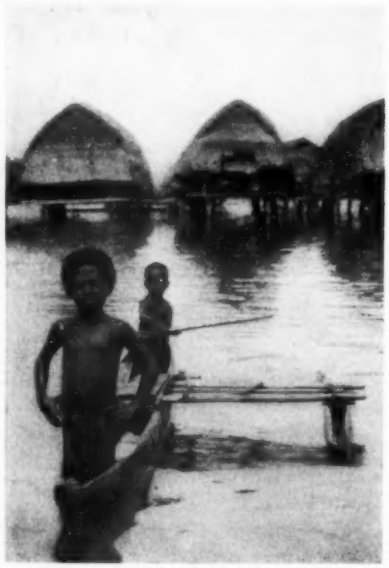
A SOUP LADLE FROM BALOWAN
When soup is given to guests at a feast, the bowl and ladle are presented to them also

thousands of dogs' teeth for a son's betrothal or his wife's silver wedding. Everyone in the wide family circle sets about preparing for the feast, part of which will be carried overseas.

Every feast has its reverberations in the markets, and upon inter-tribal trading also depend some of the large accumulations of wealth. So the man who is a successful turtle fisherman will sell his turtles for many dogs' teeth and thus add to his store against a payment for his son's bride. When the payment is made, it will be taken perhaps to Mok, to the father of the bride.

Among the villages of the Manus people there is much intermarriage, and each new betrothal or marriage means endless visiting to and fro between the in-laws. On each of these visits, some of the products of the local markets are carried back and forth. One day a Bunei canoe would return from visiting Buke connections. The pot-laden canoe would stop in Pere, and some of the pots would be exchanged for the products of the local Usiai market. Another day a Mok canoe would sail in laden with fresh coconuts from Balowan, to be exchanged for sago bought in the Usiai market. When a baby is born in Buke, its relatives in Pere make the journey from Buke to Pere to help with the birth feasts, and carry a load of property each way. When a great marriage feast is made in Balowan, the carvers set to work to make ex ra bowls to be given away at the ceremony: the recipients trade some of them to Mok men who then carry them far and wide.

So upon this double system of local markets between different peoples and a long distance voyaging between villages of the same people, a perfect exchange is maintained. All of the carrying is done by the Manus people, or very occasionally by a group of the Matankor in Manus canoes. Where relations are very friendly—as between Mok and Balowan—the Manus build canoes of Balowan wood which are regarded as partly Balowan property. But in general the Matankors depend upon the Manos to do their carrying. Toward the Usiai the Manus are less lenient. It is understood that the sea is their province—the Usiai merely skulk up and down their narrow rivers and in and out



THE MARINERS OF THE NEXT GENERATION
The youngsters are already proficient in handling their own small canoes

USIAI CARVED BOWL
Note the conventionalized crocodile handles

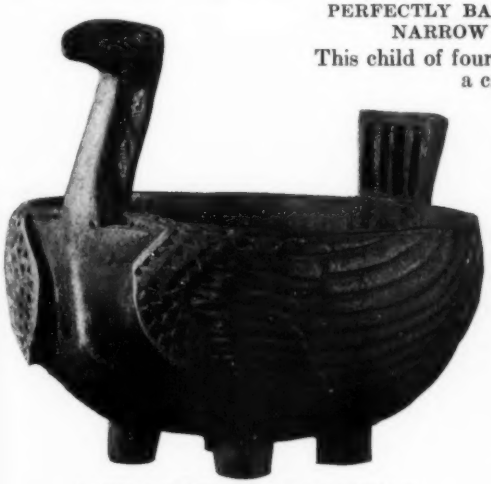
the tangles of the mangrove swamps. If a settlement boasts of one water-logged canoe hidden in the bush, it is lucky. The Manus come to them with their produce from fishing and trading—and they wait with their laden women folk for the master traders to arrive. Manners are not of the best at the market. If there has been a shortage of fish for several days, the Usiai fall over one another in a scramble to get it. Or the Usiai will develop sudden caprices and bring no rope fiber for weeks—the first to appear commanding high bidding.

At first blush this sounds like an economic system based entirely on barter among a people too primitive to have developed the idea of a currency. But this is not the case. The Admiralty Islanders have a currency which satisfies all the requirements of a good money base—it is rare, it is capable of increase only at great labor cost. It has another value besides its use as currency, it is small and extremely divisible—a respectable enough list of orthodox requirements to please any economist. This currency is of two sorts—shell money which closely resembles wampum, and even more closely the strings of shell beads used at present in the Southwestern United States—and dogs' teeth. The shell money is manufactured with great patience and expenditure of labor by the people of Ponam on the north coast. Strung on durable native fiber, it is used both as necklaces, wrapped about arms and legs, or woven into aprons which form part of the bride's dowry. The strings can be cut up into units of any size, but the measure of a man's outspread arms is the customary unit. Dogs' teeth form the more usual currency for small objects—a lime gourd will be worth two dogs' teeth, or a lime spatula five or six. The dogs' teeth have very fine designs incised upon them, they are bored at one end, and when strung, serve as collars and belts. In units of fifty or a hundred to a string they are used in marriage payments.

There are many fixed obligations which must always be met with shell

A CHERISHED WAR CHARM
This has been kept in the owner's family for several generations

PERFECTLY BALANCED ON THE NARROW GUNWALE
This child of four is quite at home in a canoe



A BIRD BOWL FROM BALOWAN
It is carved in the likeness of a wild duck

money and dogs' teeth: those incurred at marriage by the bridegroom's family, payment for a bit of magic knowledge, payment for a magical service, and so on. The dogs' teeth are taken, four from each dog, at its death—a slow rate of increase, had not the early traders imported large quantities of teeth from China and Turkey. This inflation of the currency, now stopped by government order, had the usual effect. Prices rose, a pot formerly worth one dog's tooth now sold for ten. As the importation ceased definitely, a financial equilibrium was again established. The inflation of the currency makes it possible, however, for a man to make a far finer display on the important occasion, for instance, of his payment for a wife.

CARVED BED FROM PAK
The inhabitants of the Admiralties are the only primitive people in the Pacific who use beds like this

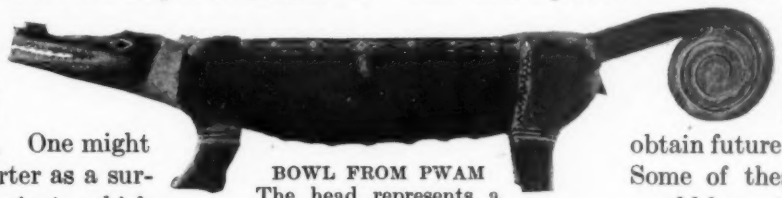
The value of every object sold or exchanged in the Admiralty Islands can be expressed in terms of dogs' teeth or shell money—a large dog's tooth is worth ten taro, ten coconuts, forty betel nuts, one bundle of bark fiber, and the like. The idea of a common medium of exchange is perfectly clear to the native mind—incidentally they are able to

DISMANTLING A HOUSE AFTER A DEATH
The thatch is loaded on canoes and paddled to another site, where the house will be rebuilt and the skull of the recently dead set up within as a guardian

UNLOADING THE SAGO LEAF THATCH
It is stored temporarily on the foundation piles of another house until the framework of the old house is set up on the new site

express the idea of a hundred thousand linguistically, while many of their neighbors only count to twenty. But here a very interesting problem arises. Although they have the idea of a medium of exchange, they do not use it as much as a quarter of the time. Instead, barter, the method of exchange which is considered so much clumsier, so much cruder and more primitive, is constantly resorted to out of preference.

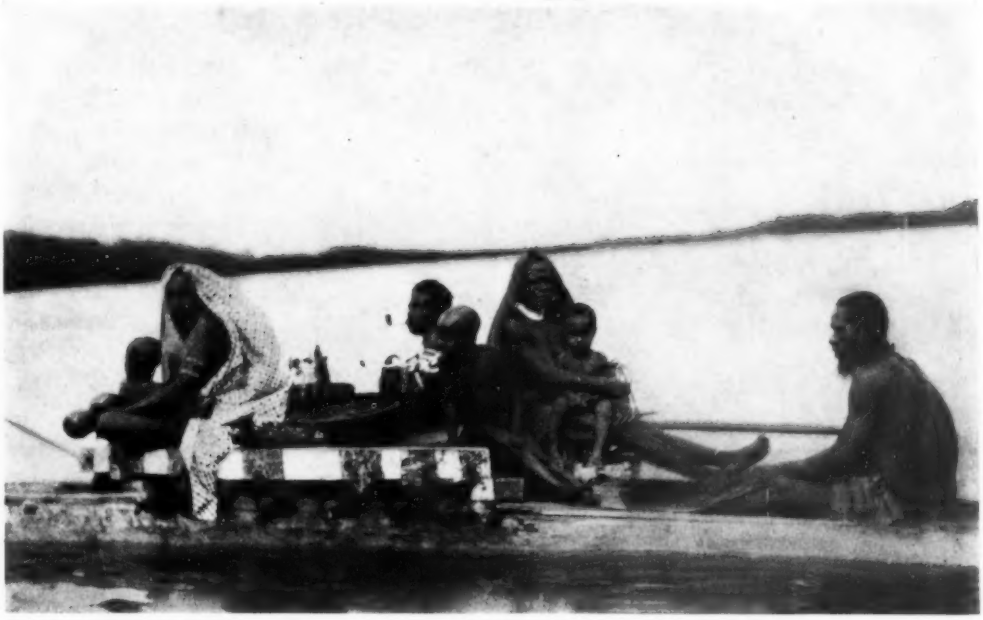
Looked at from a distance, many theories might be formulated. One might say that some of the Admiralty Islanders were too stupid to understand money, so the others deferred to them. One might claim barter as a survival against which the new concept of money had not been able to make much headway. A few weeks residence in a Manus village gives the answer to the problem. The Manus native, who is passionately proud of his honesty, enjoys "paying for dead horses;" the most efficient method of obtaining fish was to lend a native twenty or thirty sticks of tobacco with which he could meet some emergency. (Tobacco is rapidly becoming a sort of subsidiary currency). These sticks were to be paid back in fish as the native caught them. So great was their honesty that such a procedure ensured more fish than trusting to any desire to obtain future tobacco. Some of these debts would be outstanding



BOWL FROM PWAM
The head represents a crocodile, the tail a pig

PERE, A VILLAGE OF THE SEA PEOPLE
The houses, built on stilts in the shallow reef-bound lagoon, look like clusters of long-legged birds

A GROUP OF USIAI TRADERS
They are seated on the veranda of a Manus relative, where they have come to collect contributions for a great death feast



A GROUP OF RELATIVES BOUND FOR A FEAST

The cooked taro in the feast bowl is decorated with artificial flowers made of coconut meat

A MANUS CHILD'S PLAYGROUND

The streets are waterways, and in the cool shadows under the houses the children play, sheltered from the sun

THE REMAINS OF A CEREMONIAL DIET

A Manus girl holding up the remains of fish she has eaten during a month's taboo period. Her brothers caught the fish, and her father's sisters ceremonially ate all the fish heads in order to ensure her health

quite a while—a native would have bad luck in fishing, or many pressing obligations to meet. Then some of those especially scrupulous ones, restive under the debt, would try to pay it back with tobacco or money. We were immediately plunged into the barter psychology. Our money box contained a whole "fuse," as the natives call five pounds in shillings from its likeness to a dynamiting fuse. In the cedar wood boxes with the musical burglar alarm lock were sixteen pounds of tobacco, but in the "house cook" there was only canned meat. The native wishing to pay his debt in money or tobacco was turned away with a command to bring fish and fish only.

This is merely a tiny modern sample of conditions all over the archipelago. Each group of villagers are specialists—raising or making only part of the materials necessary for life. No one is dependent upon money for existence—although there are occasional individuals who only engage in activities for which they receive shell money or dogs' teeth. Such a one was Pataliyan, a widower, a returned work boy who had brought with him powerful charms from the New Guinea mainland. Wifeless and childless, he had few needs which he could not satisfy by contributing some of his payments for magic to the household where he lived. But had he been the head of a family, charged with the business of regularly providing for a household, his wealth would not have availed. It was only because his needs were slight and unimmediate that he could live so. He turned over a sum of money to his sister, for instance, and she used it to further some marriage scheme for her nephew. The nephew in turn fished for his aunt. Part of the fish went into Pataliyan's bowl, another part bought taro at the market. But the sister could not have taken the dogs' teeth to the market and

bought taro with them except under most unusual conditions. Competing with her for the taro would have been fishermen from whose hands hung whole strings of fresh glistening fish. The Usiai wants fish, he can never get enough fish, his children at home are hungry. If he sells his day's load of taro for dogs' teeth, he must go home empty handed, unless he can buy fish with the dog's teeth. But all the fishermen have come for taro or sago, or betel nuts, or bark fiber. One is giving a feast and must have an extra supply of betel nut, another must have fiber to mend his net. If he takes the dogs' teeth he stands the chance of being turned down by the Usiais who have the perishable product which he wants.

So dogs' teeth and shell money often go begging in the market. It is only the rich man who has many resources—many young people pledged to work for him daily—who can afford to snap up the money which the unsuccessful fisherman or bad gardener brings to market.

The conclusion is obvious. Where it is possible to store wealth, to accumulate against future needs, money is used, but in the hand to mouth existence of the people's daily life, barter is far more efficient. The need for proteins by the land people, of carbohydrates by the sea people, is far more pressing than either's need for money, which will command some vague, less defined good in the future. Every one is close to the subsistence level for food and so food is bartered against food. Bowls, lime gourds, lime spatulas, bags, mats, thatch, spears, fish nets, are bought and sold for money. These represent the less essential objects of wealth. But Mok people hungry for sago, sail to the mainland with a canoe load of coconuts which they will sell for sago and for sago only,

BALOWAN WOMAN CARRYING WATER

Empty coconut shells are used for carrying water, and are swung at each end of a shoulder pole, thus leaving the woman's head free for other loads

A CARVED FIGURE FROM RAMBUTCHON

This figure, which was brought from Rambutchon by traders, shows the characteristic elongated ear lobes and carvings, and the picturesque headdress of that island

(*Right*)

A BRIDE'S APRON OF SHELL MONEY

A bride wears two of these and they form part of her dowry

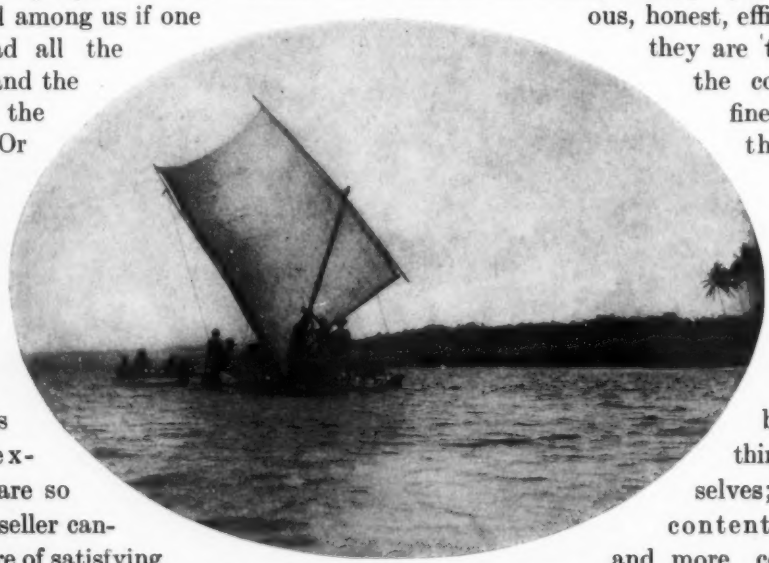
(*Below*)

USIAI CARVED BOWL

This example bears a single pair of conventionalized crocodile handles, as contrasted with the double set carved on the bowl shown at the bottom of page 120

sure of a sale, among people hungry for coconut meat to sweeten their monotonous sago diet. When such a canoe entered the village, our tobacco and shillings were useless. We had first to buy sago and then trade the packages of sago for the coconuts. The hungry Mok people were taking no chances. Similarly, in Balowan where sago is scarce, one package of sago will command ten mud hen eggs! The price of the sago in currency brings only three. Thus the Balowan people coerce those who would trade with them into bringing particular products to their shores.

There is one quaint example of this tendency outside the realm of food proper. While the land people grow the betel nut and the pepper leaf, the sea people burn and refine the coral lime with which the betel and pepper leaf are chewed. In the market the same sized fish will command ten taro or forty betel nut. But a cup of lime commands eighty betel nut, but only four taro. Betel chewing need is matched against betel chewing need, to coerce the sea people into providing enough lime for the land peoples. This would be paralleled among us if one group had all the tobacco and the other all the matches. Or a barter in rare stamps might be comparable, where the things to be exchanged are so rare the seller cannot be sure of satisfying his desires for money.



A Heavily Laden Canoe Returning After a Long Trip Overseas In Bad Weather

So the old psychology of barter lives side by side with a sophisticated appreciation of money among these people who have made such a business of trade. The sea dwellers, landless with only fishing and their knowledge of navigation to depend upon, have built for themselves a solid place in the Admiralty Island world. Lords of the sea, arbitrators of the market—the land people and the island people both rely upon them. In the attics of their large commodious houses are many dozens of pots, on their shelves are carved wooden bowls, under their arms are decorated lime gourds, with daintily carved lime spatulas projecting from the openings. Their brides are laden with aprons of shell money and strands of shell money and dogs' teeth. Their dancers stand on carved dancing poles from Lou, with combs from Balowan in their hair, spears from Lou in their hands, shell money from Ponam around their waists. Their tireless, wet, chilly vigil at all-night fishing, the dangerous oversea voyages in narrow outrigger canoes, have been rewarded well. They are a brave and enterprising people, industrious, honest, efficient, but they are traders to the core. The finest art of the archipelago passes through their hands, but they make no beautiful things themselves; they are content to buy, and more content to sell—at a profit.

Photograph by Ewing Galloway

A SAND DUNE IN DEATH VALLEY, CALIFORNIA

LAND EROSION

How the Surface of the Earth is Being Worn Away by the Action of Wind, Water, Glaciers, and the Other Atmospheric Agents which Cause the Decay of Rocks

By CHESTER A. REEDS

Curator of Geology, American Museum of Natural History

WHEN land appears above the level of the sea, its surface is subjected to the agents of erosion. Aided by gravity these agents sculpture the surface of the land into a complex series of forms which are not only beautiful to behold, since they vary greatly in character and in magnitude, but are of interest in that they have an economic bearing on the fertility of the land. The waves of the sea and of lakes also constitute a factor in that they are slowly changing the outlines of the land. Man should also be considered, for his activities are producing conditions of abnormal erosion.

Erosion is a continuous process and, while it affects only the surface features of the land, it is engaged in modifying, lowering, and removing the materials of higher elevations to lower ones and in eventually transporting them to the oceans.

It is such a slow and orderly process that it is not readily apparent to most men, yet, since it affects all land areas, which cover about 50,000,000 square miles of the earth's surface, it is a prodigious force capable of removing mountains. In fact, many a plain, plateau, and mountain, and even numerous mountain ranges, have been removed by this process during the long eras of geologic time.

Erosion affects the land in various ways. Numerous atmospheric agents, like rain, snow, frost, changes in temperature, et cetera, attack the minerals of which the rocks are composed, causing some of them to go into solution, altering others and separating out the more resisting kinds like quartz to form a mantle rock or regolith, the uppermost layer of which is known as soil. The more powerful agents, like wind, running water, and ice, pick up the decayed rock fragments

and transport them from one place to another.

Since the processes of decay and removal are continued from year to year, it is well to consider briefly the principal kinds of rock affected, as well as the work of the more active agents. It should be noted that soft rocks yield more readily to erosion than hard ones.

The rocks of the land are of many kinds. They differ from one another in hardness, in strength, in color, in texture, in composition, in age, and in origin. The more common rocks, however, may be grouped into three great classes, namely: sedimentary, igneous, and metamorphic.

Sedimentary rocks are composed of the materials of older rocks, which have been broken up into fragments and transported to different places and deposited. They are not unlike the sands, gravels, and muds now being laid down in rivers, lakes, and seas. These when consolidated will form sandstones, conglomerates, and shale, the three common kinds of mechanically laid sediments. They are generally arranged in beds or layers called strata which vary in thickness from several inches to a few feet. The strata are oftentimes horizontally disposed, but at other times they are tilted or folded due to subsequent movements within the earth.

The familiar limestone rock is a stratified rock, but the mineral matter of which it is composed was derived chiefly from the shells secreted by marine invertebrate animals. Even this shell-material comes from the older rocks, for the lime-bearing minerals were dissolved and taken in solution to the sea. In the absence of life, chemical deposits may be formed. The more important sedimentary rocks of chemical and organic origin are limestone, chert, gypsum, salt, iron ore, peat,

Photograph by Ewing Galloway

A WEATHERED SANDSTONE FORMATION, KANAB CAÑON, SOUTHERN UTAH

This view presents in cross-section the fore-set beds of an ancient delta deposit consisting of sand. The normal inclination of the strata in the fore-set beds of a river delta are still in evidence, although the erosion by wind and rain water has developed numerous parallel gullies and irregular depressions in the consolidated deposit. The soil layer is but scantily represented

lignite, and coal. These deposits may be separately formed or intermingled, producing a great variety of rocks. Such rocks contain fossils, various records of the earth's history, and point to notable changes in its surface.

Igneous rocks are those which have cooled and consolidated from a molten or hot liquid state. They arise from unknown depths in the interior of the earth and are commonly associated with the eruptions of volcanoes. The liquid rock may be called a magma or lava. All sorts of igneous rocks are formed by the solidification of magmas. They are usually massive and homogeneous in character and generally of the non-stratified type. They are non-fossiliferous and vary in texture from the noncrystalline or glassy phase to the coarsely crystalline state as noted in coarse-grained granite. The degree of crystallinity is dependent upon the rate of cooling; the large imperfect crystals of granite were formed from a slow-cooling magma. When a molten mass of igneous rock consolidates below the surface of the earth, it is called *intrusive;* if poured out on the surface it is known as *extrusive.* There are many types of rock in each group.

© *Publishers Photo Service*

THE DEVIL'S TOWER, WYOMING

A volcanic plug of andesitic porphyry, which cooled below the surface of the ground. The surrounding stratified rock which once covered the Tower, being softer, has been eroded away to a comparatively low level

Explosive action may or may not accompany the outpouring of lavas. It often occurs during volcanic eruptions, causing ejections of dust, ash, and larger fragments. These materials, when consolidated in or near the cone of a volcano, constitute breccias, agglomerates, and tuffs. When igneous rocks decay, and they all do, the decayed particles at the surface may be blown or washed away to form beds of sedimentary rock.

Metamorphic rocks constitute a large group of rocks which have been notably altered from a previous state. Either sedimentary or igneous rocks may be changed into metamorphic rocks by great pressure, by the action of underground water in modifying the composition of the rock, or by heat which sometimes assists the mineral matter to recrystallize, forming new minerals. Such changes trans-

Photograph by Ewing Galloway

THE DEVIL'S POST PILE, CALIFORNIA

Columnar structure developed by shrinkage and jointing in an intrusive basaltic rock. The structure is the same as that of the Giants Causeway in Ireland, the Devil's Tower in Wyoming, and the Palisades of the Hudson in New Jersey and New York

form sandstone into quartzite, limestone into marble, shales into slates, granites into gneisses, and modify other rocks in various ways.

All large masses of rock, whether sedimentary, igneous, or metamorphic, expand and contract due to changes in temperature. These changes produce cracks or joints which traverse the rocks and break them up into blocks of various sizes. These joints and blocks may be noted in every quarry or in rock-cuts along the highways. The joints may be vertical, horizontal, inclined, close together, or far apart. The columnar structure in basalt, an igneous rock, is due to close jointing developed by shrinkage of the upper surface of a cooling mass of intruded lava, along lines that radiate from various points at angles of 120 degrees, forming shrinkage lines, which intersect to form columns pentagonal or hexagonal in outline. The joints found in rocks not only permit the agents of erosion to pass below the surface of the ground, but they provide greater contact surfaces for these agents to work upon in bringing about the decay of the rock.

The erosion of rocks is also effected chemically by the interactions between the elements of the air and those of the earth. The air contains oxygen; the rocks contain iron in various forms. When oxygen unites with iron, it forms an oxide of iron. When water enters into the combination, it appears as iron-rust, that is, as hydrated oxide of iron. This oxidation of the iron leads to the slow crumbling of the rocks containing it. Other minerals in the rocks may be oxidized and hydrated to such an extent that the rocks will disintegrate. Carbonic acid gas (CO_2) is another constituent of the air which actively enters into combination with various elements in the rocks, such as lime and copper, to form carbonates. The result is a tendency to still further break up the original composition of the rock. Nitric acid also affects rocks in a similar but minor way. All of these chemical changes are phases of the general

process of *weathering*, which includes most of the natural processes by which rock at or near the surface is caused to crumble. Much of the soil and subsoil of the earth have been produced by them. Soils which have been developed out of the underlying rocks in this manner are known as residual soils. When the rocks are broken up by these processes of weathering, their particles are more readily transported by wind, water, and ice. Soils formed from transported material are known as transported soils.

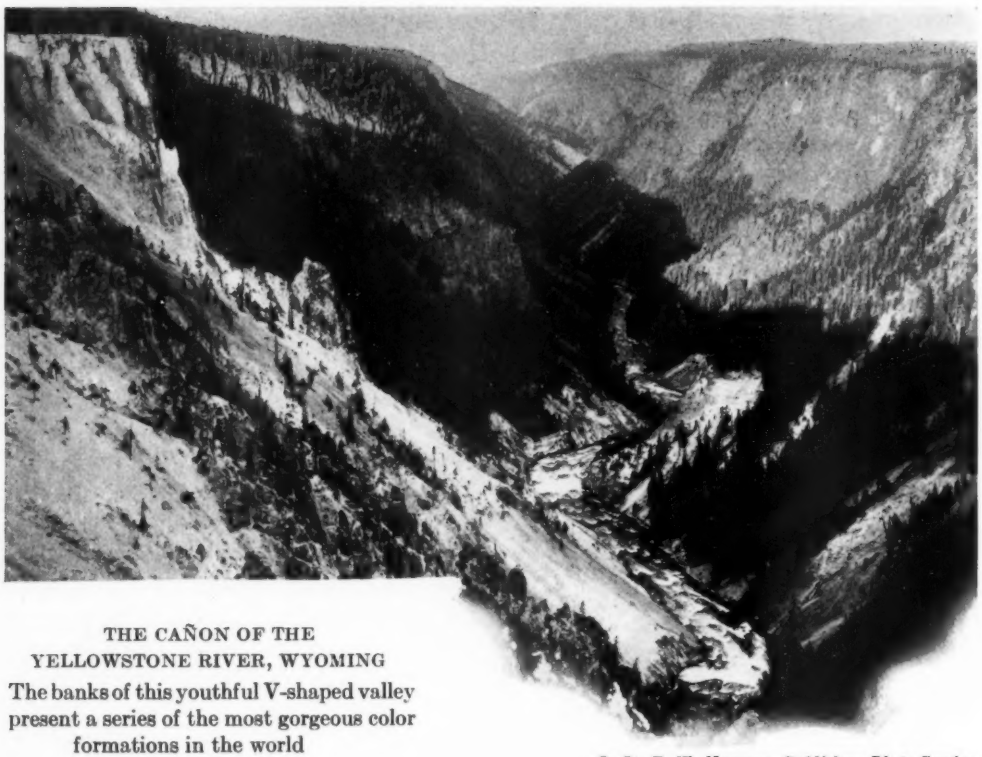
In many regions the water in the soil freezes during the winter. While the ground is frozen, the wind and running water do not carry the soil away but the expansion which takes place when water is converted into ice, about one-tenth of its volume, causes a breaking up of the rock particles composing the soil and a widening of the joints between the underlying blocks of rock. This process of rock-breaking is most important where there is abundant moisture, and where the changes of temperature above and below the freezing point of water are frequent, that is, in middle latitudes, or in mountainous regions which have the temperature of middle latitudes.

During the summer months and in places where large areas of bare rock surfaces are exposed, the rock becomes heated by day and cooled by night. Where the daily changes in temperature are great, the surface of the rock becomes very hot during the day, but not for great depths, since rock is a poor conductor of heat. This differential heating of the rock causes exfoliation, that is, expansion and flaking off of the outer surface. At night time, when the reverse process sets in, the outer surface cools more rapidly than the inner and causes an unequal shrinkage of the rocks, resulting in a peeling off of the outer portions.

By DeCou from Ewing Galloway

ELLERY LAKE ON TIOGA ROAD, NEAR TIOGA PASS, CALIFORNIA

A fine example of a talus slope developed by the weathering of granite appears across the lake. Tioga Road connects Yosemite National Park with Lake Tahoe in the high Sierra Nevada Mountains



THE CAÑON OF THE YELLOWSTONE RIVER, WYOMING
The banks of this youthful V-shaped valley present a series of the most gorgeous color formations in the world

© By E. W. Newman, Publishers Photo Service

This expansion and contraction of rock by alternate heating and cooling are very common phenomena and may be noticed in cities where sidewalks buckle and break. The lower surfaces of steep cliffs and mountains are covered with rock débris of varying sizes known as talus which has been loosened from the higher levels by alternate freezing and thawing, expansion and contraction of the rock, and moved to lower levels by gravity. This process of rock breaking is a phase of weathering.

Plants penetrate the soil, loosening it, and thereby assist water to get below the surface. Roots frequently find lodgment in cracks and with continued growth they act like wedges and thus assist in forcing the rock asunder.

The rock material loosened by the various processes of weathering is sometimes called the *mantle rock*, since it covers the solid rock which lies below. It is also known by the terms *rock waste* and *regolith*. It may vary in thickness from a few inches to many feet. The upper surface of the mantle rock is commonly known as the soil layer, since it contains humus and supports the plants that grow therein. It may vary in color and be either clayey and compact or sandy and porous. Beneath the soil layer is the *subsoil* which is usually of a different color and has a greater density than the soil layer. If the soil layer is suddenly removed, it will be noticed that the subsoil does not readily support vegetation. Beneath the subsoil occurs rock in process of decay.

Wind is a potent agent in removing particles of rock already loosened and in blowing sand and dust against rock surfaces, producing a sand-blast effect which not only abrades but in time wears away

even the hardest kind of rock. This is particularly true of arid and desert regions where there is little or no rainfall and where vegetation is scanty or lacking. The sandy soil being loose is readily picked up by the wind and either driven against the exposed rock surfaces or drifted into dunes. Since the wind picks up only dry sand, the work of the wind is not so apparent in humid regions as in arid ones. In moist areas where rainfall promotes the growth of vegetation, bare rock surfaces are rare, and the soil is protected by a mat of plant life. Being shorn of its tools, the wind does little abrasive work.

Where rocks are of unequal hardness and there is no cover of vegetation, the softer rock will be worn away by wind action more rapidly than the harder one. Should the soft formation be capped by a layer of hard rock, mushroom-like columns of weird designs may be produced. Such forms are of common occurrence in Monument Park, Colorado, and in the southwestern portion of the United States.

In the desert the movement of sand and dust by the wind is almost incessant. Much of this material is also carried out of the deserts by the winds and allowed to settle elsewhere. Thus the surface of the desert is being slowly modified as well as lowered. During desert storms, sand and dust amounting to more than a hundred thousand tons per cubic mile of air may be lifted and transported. As soon as the velocity of the wind decreases, the heaviest particles will settle to the ground, but the finer particles will float for hundreds of miles from their source and give rise to the thick deposits of loess such as that found in China, central Europe, and the Mississippi valley states. The ancient cities of northern Africa, the Euphrates valley, and western Asia have been covered for the most part by wind-borne dust and sand.

The water of streams is the most important single agent modifying the land surface. According to the late Sir John

© *Publishers Photo Service*

THE NEEDLE'S EYE, BLACK HILLS, SOUTH DAKOTA

Note the large slab of rock beneath the man's left hand, which has been freed from the main mass by the alternate expansion and contraction of the rock induced by daily changes in temperature

© *By Hileman, Ewing Galloway*

MORNING GLORY LAKES, GLACIER NATIONAL PARK
Two lakes now occupy these glacial cirques, large amphitheater-like depressions with steep back walls, which were eroded by small horsehoe-shaped glaciers known as "cliff glaciers"

Murray, about 29,347 cubic miles of rainwater fall upon the land surfaces of the earth every year. About one-third of this amount evaporates, a large amount soaks into the ground, and about one-quarter runs off. These proportions are modified in various regions by climatic conditions, the porosity of the surface rocks, ruggedness and steepness of slope of the landscape, et cetera. A considerable amount of the water which soaks into the ground eventually enters the streams in the form of seeps and springs. Rivers also receive contributions from ponds, lakes, snow-fields, and glaciers.

The rivers in the aggregate deliver to the sea about 6,524 cubic miles of water annually. When it is considered that the average height of the land above the sea is nearly a half mile, and that this large amount of water must descend slopes which aggregate about a half mile in height, it is seen that great energy will be developed. The water of the rivers has the same amount of energy that it would have if it fell vertically. This great force is expended in cutting away the sides and bottoms of the valleys and in modifying the surface of the land. Whether the region under consideration be one of mountains, plateaus, or plains, rivers act in very much the same way in each type of region, hence, what is true of river action in one area is true of that in another.

It has been observed that streams are more numerous in regions where rainfall is abundant than in those areas where it is scarce; that many small streams are revived with each fall of rain or melting snow; that streams are swollen after rains, especially after heavy rains; that, in arid or semi-arid regions, small streams flow only after heavy rains or during rainy periods unless they are fed by springs, lakes, or melting snow and ice. It is thus apparent that rivers are dependent on atmospheric precipitation for their supply of water.

The familiar rain-wash is the beginning of stream erosion. As the water begins to

flow down the slopes of the land, it picks up and carries with it particles of soil and weathered rock. Presently it forms a rill, or perhaps a gully, leading to older gullies or valleys, increasing its load all the while as it progresses toward the flowing stream which it enters. The water which flows down freshly plowed slopes is usually very muddy, while that which runs over grass or forest-covered slopes carries away little soil, since the roots of the vegetation hold it. The removal of forests from hill and mountain slopes and the subsequent cultivation of the soil often lead to the complete removal of the soil, as in many of the abandoned farms of the southern Appalachian Mountains.

Where the run-off is concentrated into streamlets, little gullies are oftentimes made by a single shower. Older gullies formed by previous rains may be lengthened headward and their valleys cut deeper. This is especially noticeable in soft formations in semi-arid regions such as in western South Dakota, or in arid regions, where "cloud bursts" are not uncommon.

During the winter and spring months the rivers of the land are apt to be in flood following heavy rains and the melting of winter snows. At such times the waters are usually muddy, due to the removal of rocky waste from the weathered surface of the land. In addition to the mud which the streams carry in suspension, they may roll sand, gravel, and bowlders along their bottoms. The sediment carried by a stream, whether in suspension or at the bottom, is its load. The fine sediment, and the sand, gravel, and bowlders, constitute the tools which a stream uses in cutting its channel deeper and in widening its valley. The finer

© *Publishers Photo Service*

ONE OF NATURE'S CATHEDRALS, BAD LANDS, SOUTH DAKOTA

Through many hundreds of years these horizontally stratified beds of a weak formation have been exposed to the agents of erosion. Many a fantastic spire in varied colors has been carved out of the deposits which contain the bones of prehistoric creatures. To look upon this weird landscape under the various lights of day or a moonlight night gives one the impression that he is indeed back in a Spirit Land of prehistoric days. The Bad Lands are a warning to the nation and to those farmers and herdsmen who do not pretend to conserve the inherited soil of the ages from the daily forages of the agents of erosion

Photograph by Ewing Galloway

THE MOST AWE-INSPIRING VIEW IN AMERICA

The Grand Cañon of Arizona as seen in sunset light from Pima Point, with the Colorado River winding through the gorge a mile below. The inner, outer, and some tributary gorges are in evidence below the plateau surface which appears in the background. This is the most stupendous example of river erosion in the world

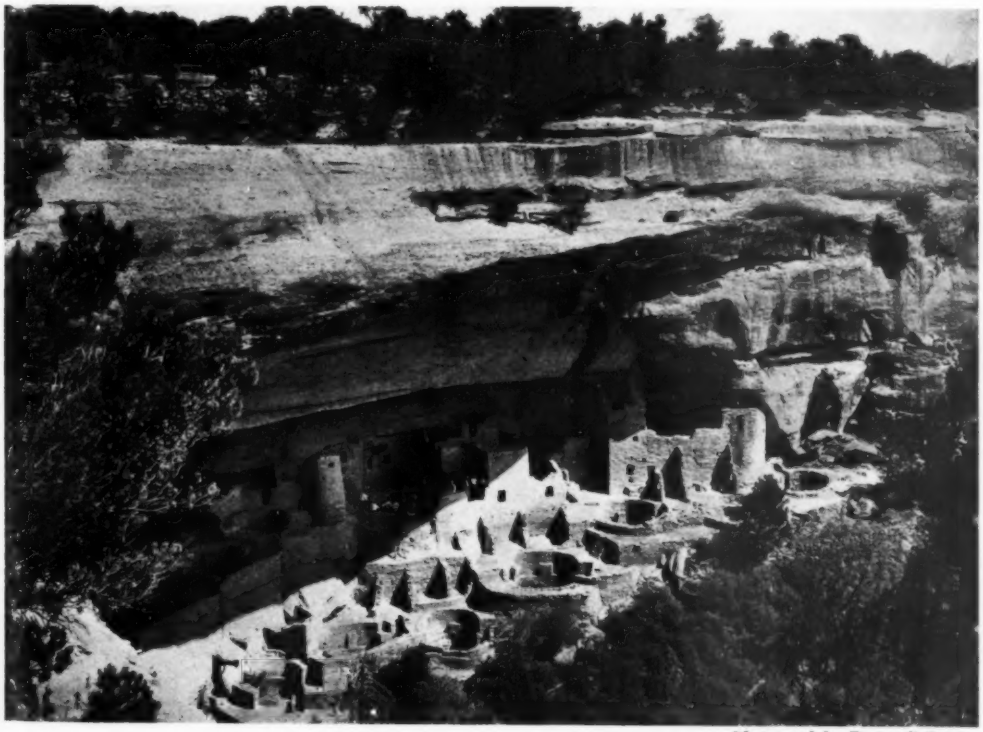
material, which is nearly three times as heavy as water, is kept in suspension by the minor upward currents in the main stream. The greater the volume of water and the greater the velocity of the streams, the greater the load of sediment the river can carry. The carrying power of streams varies as the sixth power of the velocity, hence, when rivers are in flood, they are able to move large bowlders. Streams, however, carry a much greater weight of fine material than of coarse, since the fine material can be spread more widely and taxes the stream's energy less. Swift streams flow in channels which have steep gradients; as the valleys are deepened, the gradients become less and the streams flow more slowly. Cañons like the Colorado and the Yellowstone are being made deeper, since their stream gradients are still steep. Such valleys are never found in plains. Valleys of such depth are found only in plateaus and mountains. The depth to which a valley may be eroded is determined by the height of the land and the elevation of the body of water into which its river flows. The volume of water carried by a river may be so great that it is able to cut its channel below sea level, as the Mississippi has done from Baton Rouge to the Gulf, where it maintains a channel about one hundred feet below sea level.

The erosional history of a stream may be judged from the character of the valley along its course. Where the valley is V-shaped and narrow, with waterfalls in evidence, and its tributaries short, it is still youthful. Where the valley is moderately wide, its slopes gentle, and its tributaries long, it is said to be a mature valley. Where the valley is wide and has a broad, flat, flood plain and a low gradient, it is an old valley. A stream also exhibits a similar history. In youth it is swift and impetuous, unless it flows

through a low-lying country. In maturity it is steadier in its flow and habits. In old age it meanders across its wide flood plain. Streams may be rejuvenated, however, throughout their entire length or for a part of their course, by an uplift of the land. Then we see them hastening on their way, following all the old bends and meanders in their course as they cut their channels deeper. A new cycle of erosion has begun and there is much work for the stream to do to keep its channel open across a rising land.

As a stream passes from the youthful to the mature stage, it may widen its valley by (1) under-cutting its bank as it swings from one side of its channel to the other; (2) by rain-wash on the adjacent slopes slowly wearing back the hillsides; (3) by loose material slowly creeping down the hillside toward the river under the action of gravity aided by other forces such as changes in temperature and viscosity of the material when wet; (4) by slumping of the loose material from higher to lower levels when soaked with water; (5) by the action of animals in burrowing and walking near steep slopes; (6) by the overturning of trees on valley slopes; (7) by the action of the wind in carrying away the smaller particles when dry and loose; and (8) by the development of talus slopes. The limit to which a valley may be widened is determined by the distance to the divides between the stream under consideration and that of the adjacent streams.

While widening its valley, a stream may also cut down its channel to a low



Photograph by Ewing Galloway

A MEDIÆVAL CLIFF CASTLE, MESA VERDE, COLORADO

This famous relic of ancient Indian civilization is in southwestern Colorado. The recent study by Dr. A. E. Douglass of tree rings found in the roof timbers and their correlation with the known tree ring chronology show that these buildings were erected 1073-1262 A.D. The erosion of the cliff recess and cañon began many thousands of years ago

gradient, at least for a portion of its course, and develop marginal flats or flood plains which usually appear a few feet above the water in the main channel of the stream and considerably below the surface of the bordering upland.

Since all lands are being lowered by erosion, it is of interest to know how fast they are being worn away. It has been estimated that the Mississippi River, for example, carries to the Gulf of Mexico more than 400,000,000 tons or 7,500,000,000 cubic feet of sediment each year, or more than 1,000,000 tons a day. This would afford enough material to cover one square mile to a depth of 268 feet. All of the rivers of the earth are probably carrying to the sea about forty times as much sediment as that carried by the Mississippi.

© *Publishers Photo Service*

A TREE GROWING IN THE CRACK OF A ROCK
As the tree grows larger, the roots act as a wedge which splits open the rock

There is still another factor to be considered. The rain-water which enters the soil to form the ground-water, found in wells and which issues from hillsides as seeps or springs, dissolves various mineral matter in the rocks before it enters the rivers and lakes of the land. This dissolved matter carried by streams is invisible, yet it has been estimated from numerous chemical analyses that it amounts to nearly 2,753,000,000 short tons for the rivers of the United States and about 5,000,000,000 tons for all the rivers of the world. These totals for dissolved matter amount to about one third as much as the sediments carried by the rivers.

When the mechanically transported sediments and the dissolved matter carried in solution by streams are totaled, it may be observed that the rate at which the surface of the Mississippi basin is being eroded is about one foot in 3500 years. This may represent the approximate rate at which the lands of the earth are being lowered by erosion at the present time by natural processes.

Glaciers not only erode the surface over which they pass, but they carry and eventually deposit the material which they acquire in transit. Soil, stones, and large blocks of rock may freeze into the bottom of a glacier and be carried along as it slowly moves forward. The stones, which have been frozen into the bottom of the mass of ice, serve as tools for grating away the soil layer and projecting masses of rock as the glacier advances. The effects of glacial action are thus (1) the removal of loose rock débris from the surface, (2) the wearing down of protruding masses of rock which it overrides.

In a plains region an ice sheet may move across or along valleys and over considerable hills without being diverted from its course. Where it moves across a valley it tends to fill it up with rock débris and abrade its margins, but where it

Photograph by Ewing Galloway

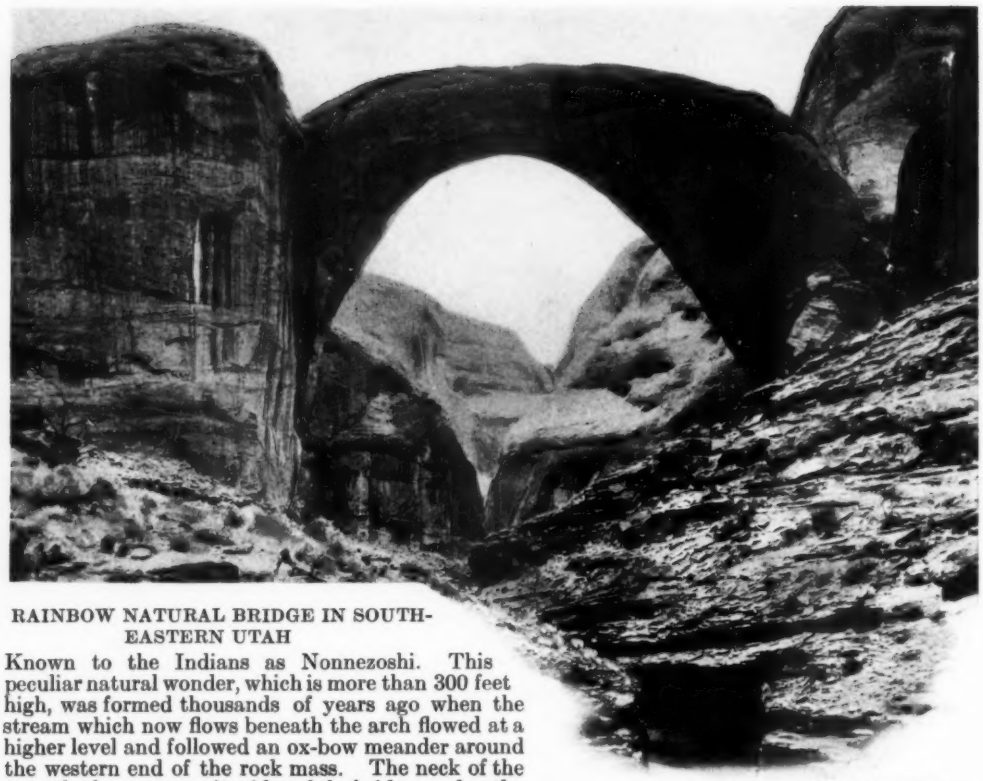
BRYCE CAÑON IN SOUTHERN UTAH

It is a vast maze of colorful monoliths some of them 200 feet high, and thousands of people go there each month to behold its overwhelming beauty. The district is now a national park

Photograph by Ewing Galloway

THE BAD LANDS IN TOWER'S GULCH, DEATH VALLEY, CALIFORNIA

An intricate series of gullies developed in a soft formation by rain wash. In the absence of a protecting cover of vegetation, erosion is rapid. This view is also typical of the Bad Lands of South Dakota, and of the abandoned farms in the southern Appalachian Mountains. In the old days of '49, many perished in this vast sun-scorched area in eastern California near the Nevada border, where the temperature rises to 130 degrees in summer and drops to 30 degrees below zero in winter



RAINBOW NATURAL BRIDGE IN SOUTHEASTERN UTAH

Known to the Indians as Nonnezoshi. This peculiar natural wonder, which is more than 300 feet high, was formed thousands of years ago when the stream which now flows beneath the arch flowed at a higher level and followed an ox-bow meander around the western end of the rock mass. The neck of the meander lay on opposite sides of the bridge, and as the stream continued to undercut its banks and these points, it eventually developed a hole in the rock. Then the stream abandoned the meander and took the short cut through the hole. During the ages which followed, the stream has cut its bed to lower levels, the sandstone rock of the bridge has exfoliated along the outer surface, and this, with wind erosion, has tended to lengthen and narrow the arch

Photograph by Ewing Galloway

follows a valley it scours it out. In mountainous regions, however, previously existing valleys determine the direction of movement of glaciers. These valleys are widened and deepened and made smoother by the passage of the glaciers; in fact, they are transformed from V-shaped into U-shaped valleys. Tributary valleys bearing smaller glaciers are not eroded so deeply as the main valley; hence they form hanging valleys. The glaciers of hanging valleys have a steep descent near their heads, which affords a site for great erosion. As the head of the glacier works its way back farther and farther into the mountain, it develops a horseshoe-shaped depression with a steep back wall about its head and sides known as a cirque. Cirques are of common occurrence in the Alps of Europe and in the Bighorn, Uinta, and Sierra Nevada mountains of the United States. These huge amphitheaters are oftentimes excavated in solid rock, and, after the cliff glaciers which occupied them have disappeared, the rock basins may become the sites of charming little lakes which add beauty to the mountain scenery.

In addition to the large amount of eroded material which is carried in the basal portion of a glacier, some rock débris may be carried at higher levels in the ice and also on the top of the glacier. The material carried on the surface of a glacier may be derived from steep mountain slopes by avalanches, or as talus from

adjacent cliffs, or as wind-blown dust. Marginal accumulations of rock débris are known as lateral moraines. Where two or more glaciers unite, lateral moraines may be brought to a medial position and united, forming medial moraines. The thick accumulation of rock débris at the end of a valley glacier or at the margin of an ice-sheet is called a terminal moraine. As a glacier or ice-sheet melts away, all the rock material which it carried is left strewn over the surface of the ground and is known as a ground moraine. The rock débris left by the ice is commonly known as glacial drift. New England and New York State and the states to the westward were extensively glaciated at various times during the Pleistocene epoch, or Glacial period. The southern limit of glaciation, which is marked by a huge terminal moraine, extends from Montauk Point, Long Island, westward, across Staten Island, and then west-northwest across the United States to the Pacific Ocean near Seattle, Washington. Glacial drift deposits are commonly recognized as a heterogeneous mixture of irregularly shaped bowlders, gravel, pebbles, sand, and clay. The amount of glacial drift material in North America and Europe is so enormous that no accurate estimate of it has ever been made.

In addition to the erosional effects produced by wind, rivers, and glaciers, the waves of the sea and of the many inland lakes are continually modifying their shorelines. The changes produced during a year are slight in comparison with those developed during a decade or a century. While the waves modify the outlines of the land rather than its relief, they do effective erosional work in the shallow water near shore. They form re-entrants in the weaker formations and

Photograph by Ewing Galloway

A DOUBLE OX-BOW MEANDER, TROUT CREEK, YELLOWSTONE NATIONAL PARK

These meanders have been developed on the delta plain of Trout Creek between Lake Junction and Cañon Junction near the entrance of the stream to Yellowstone River

Photograph by Ewing Galloway

AIRPLANE VIEW OF NIAGARA FALLS, NEW YORK

The Niagara River, which connects Lake Erie with Lake Ontario, is clearly outlined above and below the Falls. Although the river has cut a gorge seven miles long below the Falls during the last 25,000 years, it has much work to do before the Falls recede up stream to where they will become rapids

Photograph by Ewing Galloway

A VIEW IN THE ENDLESS CAVERNS, VIRGINIA

It took untold millennia for the underground waters to erode this cave in the limestone rock. The beautiful rock stalactites and stalagmites which were deposited later were formed by minute particles of calcium in the water that dripped for centuries from the roof of the cave. The two men in the picture have gained permission to saw off one of the stalactites for the Milwaukee Museum

© *Publishers Photo Service*

A RURAL LANDSCAPE OF THE RIVER LEE, IRELAND

A slightly meandering stream with flood plains and valley slopes protected from erosion by a cover of vegetation. The River Lee rises in Lake Gougane-Barra. The various fields are separated by lines of stone and shrubbery

Photograph by Ewing Galloway

THE MISSISSIPPI RIVER FROM THE 200-FOOT BLUFFS AT NATCHEZ, MISSISSIPPI

The adjacent lowlands are lower than the level of the water in the river, since both natural and artificial levees have been built along the river's banks. During floods the river frequently breaks through the levees and does great damage to crops in the lowlands. Due to its low gradient, the river has developed many meanders and ox-bow lakes between Cairo, Illinois, and Baton Rouge, Louisiana

Photograph by Chester A. Reeds

A PARTING GLIMPSE OF THE YOSEMITE VALLEY, CALIFORNIA

This view was taken from the rim as a rain storm was casting its misty veil over the valley. The granite precipice of El Capitan is still visible on the left. The towering peaks of the Three Brothers and Yosemite Falls are outlined on the right. Many a rain storm, snow storm, and glacier have worked their magic over this landscape to make it one of the great natural wonderlands of America. The valley has been eroded to a depth of 4000 feet

headlands of the stronger rock. On rocky coasts steep cliffs may be developed and undercut by the waves as they drive pebbles and other rock débris against the shore. In such cases wave-cut terraces are not uncommon a little below the surface of the water. Wave erosion is thus effective in modifying coast-lines.

Man is also an active agent in modifying the surface of the land. He builds cities and towns with tall buildings, paved streets, sewers, aqueducts, reservoirs, and thus alters the natural character of the landscape. In building railroads and highways he makes cuts through hills and fills in valleys. He digs canals, builds dams and bridges across rivers, and erects levees to confine rivers to specific channels, and modifies the natural erosive action of running water in many ways. He tills the land and in so doing destroys the native vegetation, turns over the soil with the plow and the harrow, and thus prepares the way for the more effective action of wind and running water.

The prevailing attitude of most farmers toward soil erosion is an inactive one. They are doing little or nothing to check it and much to accentuate its evil effects. Thousands of farmers have moved to town or to other farms because of the poor condition of the soil on farms that were once highly productive. The topsoil having been washed off and the fields riddled with gullies, the cultivation of many farms has been abandoned. The areas relinquished to rapid erosion are increasing every year and at a much faster rate than new soil is being formed. A 1928 circular entitled "Soil Erosion a National Menace" by H. H. Bennett and W. R. Chapline, published by the U. S. Department of Agriculture, shows that between 40 and 50 per cent. of the land now tilled in the United States has suffered to some degree from abnormal soil erosion, and about one-fourth of this has suffered seriously. Under normal conditions rock decay keeps pace with soil removal, but where man removes the

forests and shrubs and breaks the ground for cultivation, he accentuates erosion to a degree far beyond that taking place under average natural conditions.

It has been stated that no less than 126,000,000,000 pounds of plant-food material are removed from the fields and pastures of the United States every year. Most of this is from cultivated and abandoned fields and overgrazed pastures and ranges. The value of this plant-food exceeds $2,000,000,000 annually. Of this amount at least $200,000,000 is lost by the farmers, and they are not in an economic position to stand the loss.

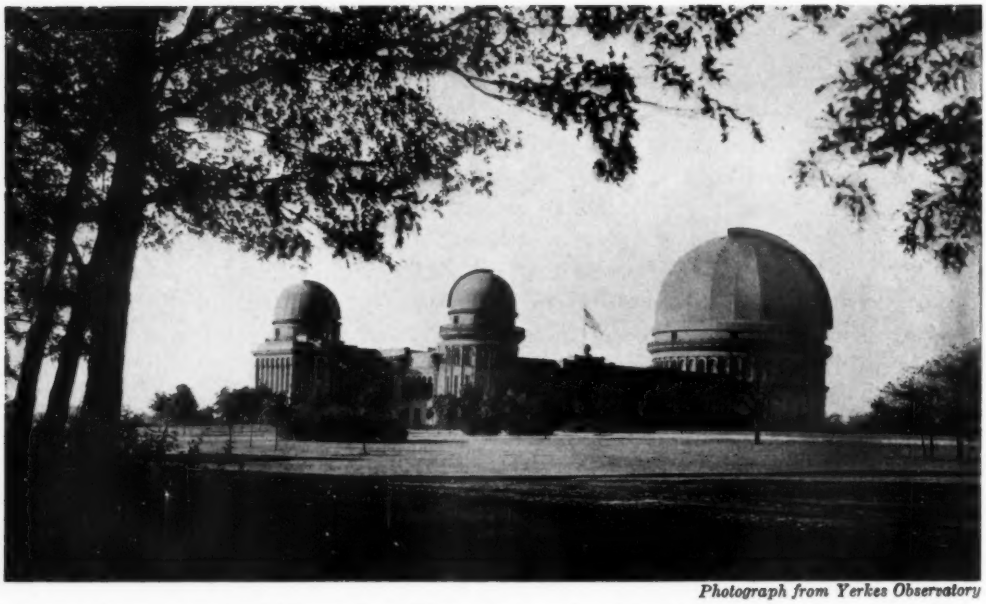
In the United States about ten million acres of land which was formerly cultivated have been permanently ruined by abnormal soil erosion, and an additional three million acres of fertile valley lands have been rendered useless or impaired by overwash of sand and gravel due to choking of stream channels. It is not necessary to go to China, northern Africa, or to some other parts of the world to see what eventually happens to unprotected slopes of cultivated areas. There are already an abundance of them in the United States. In 1908, the late Prof. T. C. Chamberlin, a famous geologist, stated: "The rainfall is an inherited asset, the soil an inherited asset, but reckless soil-wastage is a serious error."

In conclusion it may be stated that erosion of the land is a natural phenomenon which consists of three somewhat rather distinct but related processes namely: (1) weathering, which embraces the decay and disintegration of the rock, (2) corrosion, the gathering up of the loose material set free by weathering, and (3) transportation, the carrying of the loose material from one place to another. The products of normal land erosion are very beneficial to man, since they afford suitable soils for plants. Due, however, to man's unwise deforestation and cultivation of extensive tracts of land, many areas have been rendered useless by the enormous wastage resulting from erosion. In various regions it is imperative that the extensive abnormal erosion be checked. This may be done by reëstablishing the vegetative cover.

© *Publishers Photo Service*

THE NORTHERN FACE OF MT. McKINLEY, ALASKA

This view taken from the low tundra shelf shows the mountain enshrouded in snow and ice. Mt. McKinley, 20,000 feet above the sea, is not only the highest mountain in the world above its own base, but also the highest above the line of perpetual snow



Photograph from Yerkes Observatory

Yerkes Observatory, at Williams Bay, Wisconsin is under control of the University of Chicago

THE ASTRONOMER'S WORKSHOP

The Instruments Which Man Has Invented to Span the Distance between the Earth and the Stars

By CLYDE FISHER
Curator of Astronomy, American Museum

Go to yon tower, where busy science plies
Her vast antennæ, feeling through the skies;
That little vernier, on whose slender lines
The midnight taper trembles as it shines,
A silent index, tracks the planets' march
In all their wanderings through the ethereal arch,
Tells through the mist where dazzled Mercury burns,
And marks the spot where Uranus returns.

—Holmes.

THE telescope is usually thought of as the primary, indispensable tool of the astronomer, and in the minds of many it is the only instrument thought of in connection with his work. While the telescope has been of vast service to the science of the heavenly bodies, much was accomplished before the days of Galileo.

The first astronomer was the first man, and the foundations of the science were laid before the dawn of history. Many of the conspicuous star-groups or constellations were delimited and named. While most of the names that have come down to us are from Greek mythology, various primitive peoples, such as the American Indians and the Lapps, had independently recognized various constellations which differed more or less from those accepted by the modern astronomer. Certain bright stars were named. All of the planets except Uranus and Neptune were known, as was their movement among the stars. The name "planet" signifies "wanderer."

More than two thousand years ago,

Hipparchus, the father of astronomy, had determined the length of the year within an error of four minutes. After Hipparchus, the most distinguished astronomer of antiquity was Ptolemy, whose system was orthodox astronomy for fourteen hundred years. Nearly three quarters of a century before the first astronomical telescope was made, the Copernican system of astronomy was born.

Galileo, who built the first astronomical telescope, made many thrilling discoveries. He was the first to see the mountains and craters on the moon, the first to see Venus as a waxing and waning crescent, the first to see the four large moons of Jupiter. Galileo was the first person to make a scientific study of sunspots, although there are records that sunspots were seen by the Chinese before the invention of the telescope. Because of the small size of his telescope, he never gained an adequate notion of Saturn and his rings. According to tradition, upon first examining Saturn through his telescope, Galileo exclaimed that he had discovered the star with wings. When we examine modern photographs of Saturn made through much larger and better telescopes than that of Galileo, we are not surprised at this comparison.

In the refracting telescope, or refractor, as it is commonly called, the large lens or object-glass is a critical part. At the present time, in all large telescopes the object-glass is made of glass. At first the object-glass was made of a single lens which was convex on both sides. But this was unsatisfactory because of color fringes, due to the fact that white light is dispersed into a number of different colors when passed through a prism,—and a lens may be considered to be made up of an infinite number of prisms. For

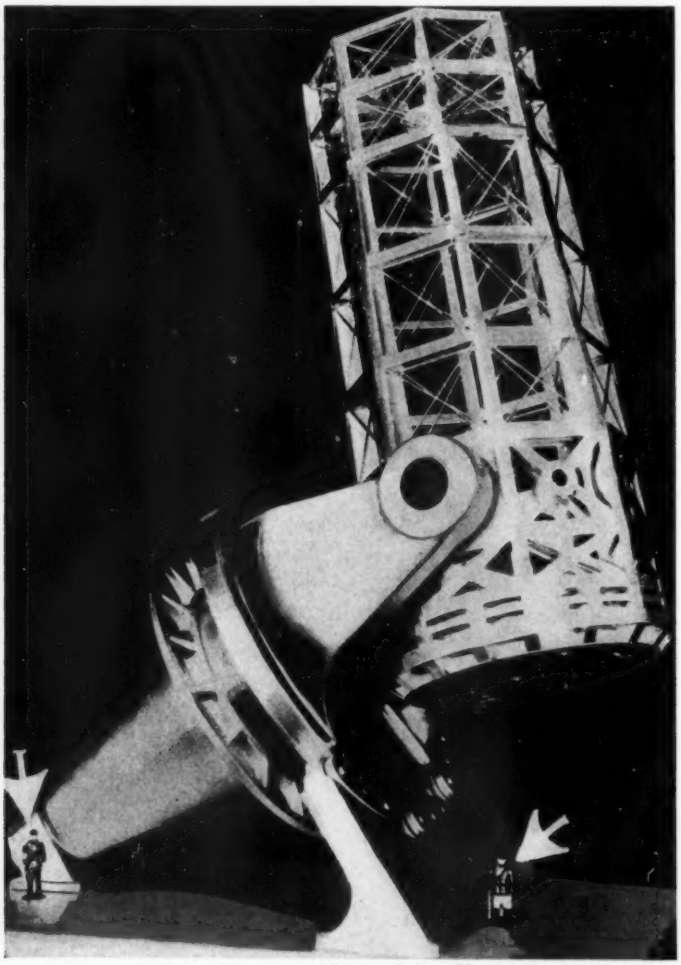
Photograph from Mt. Wilson Observatory

DOME OF THE WORLD'S LARGEST TELESCOPE

The dome of the 100-inch Hooker reflector at Mt. Wilson Observatory, photographed from the 150-foot sun-tower

a hundred years after Galileo's time, little progress was made in the telescope because of the inability to cope with this so-called "chromatic aberration." Finally, when the remedy was discovered, it was suggested by the structure of the human eye, which contains more than one refractive medium. Following this hint, the object-glass of a telescope or of a field-glass or even the achromatic lens of a camera is made of two lenses, one of which is bi-convex and consequently thicker in the center, and the other of glass of a different density and thinner in the center. These two lenses are usually cemented together with Canada balsam, which has the same index of refraction as glass.

The glasses for the largest refracting telescope in use in the world were made by M. Mantois of Paris, and were ground and figured by the celebrated firm of Alvan Clark and Sons of Cambridgeport, Mass. This mammoth lens of forty inches aperture is mounted in the big Yerkes telescope which, with all its intricate machinery for operating, was designed and built by Warner and Swasey of Cleveland.



Photograph from Monthly Evening Sky Map.

MODEL OF THE GREAT 200-INCH TELESCOPE

The California Institute of Technology is planning a 200-inch reflecting telescope, which will probably be installed at some advantageous place in California. It will have four times the light-gathering power of the 100-inch reflector at Mt. Wilson

It is evident that in grinding and polishing an object-glass for a telescope there are four surfaces to be shaped. This necessity for so much skilful and accurate work, together with the difficulty in manufacturing a large disk of glass of high quality, has led builders of large telescopes to turn to the reflecting type, because in the latter there is but one surface to grind and figure, that is, the paraboloid surface of a concave mirror. The large lens or object-glass of a refracting telescope bends or refracts the rays of light to a focus, while in a reflecting telescope the rays of light are gathered and reflected to a focus.

The largest telescopes in the world are reflectors, — the 100-inch Hooker telescope at the Mt. Wilson Observatory

Photograph from Harvard Observatory.

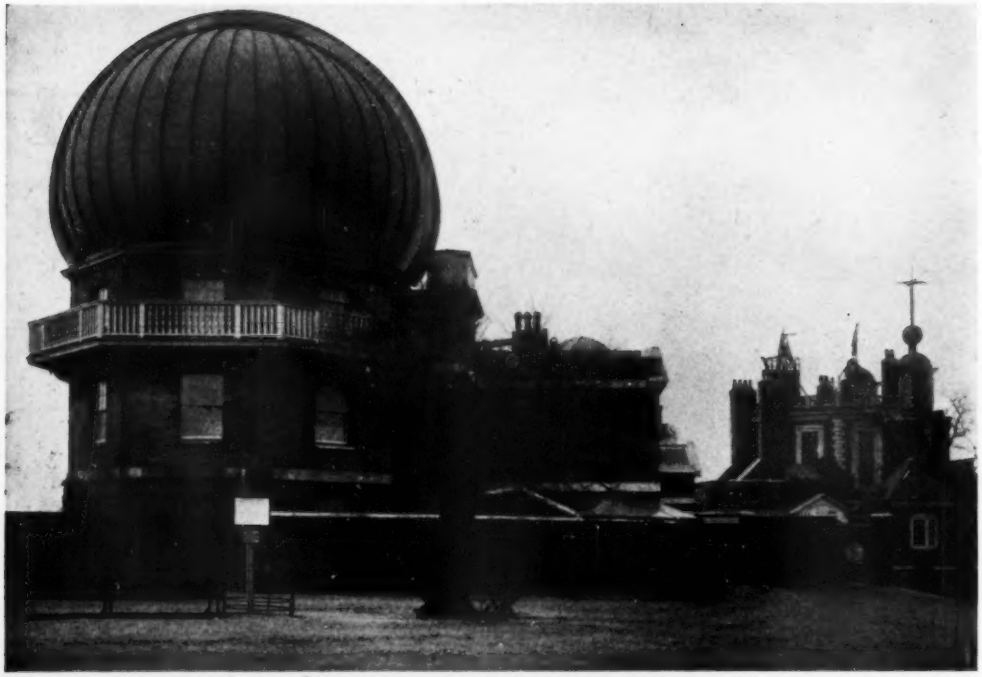
HARVARD OBSERVATORY

Harvard Observatory owns the largest and most valuable collection of astronomical negatives in the world. Its big reflecting telescope is of historic interest in this connection, being the first through which an astronomical photograph was made. Dr. Harlow Shapley is the present director

being first in point of size, and the 72-inch reflector at the Dominion Astrophysical Observatory, Vancouver, being second. A reflector almost as large as the latter is being constructed for the Perkins Observatory at Ohio Wesleyan University.

A huge reflecting telescope, 200 inches in diameter, has been projected by the California Institute of Technology, and is under way. Since it required some six years to build the 100-inch reflector, one should not be too hopeful about eliminating the element of time in the present case. The 200-inch mirror will have four times the light-gathering power of the 100-inch, and its use may make possible the solution of many problems which now puzzle the astronomer. Possibly we may settle the long discussion about the so-called canals of Mars, and probably we shall get more light on the curvature of space by examining some of the extremely distant spiral nebulæ.

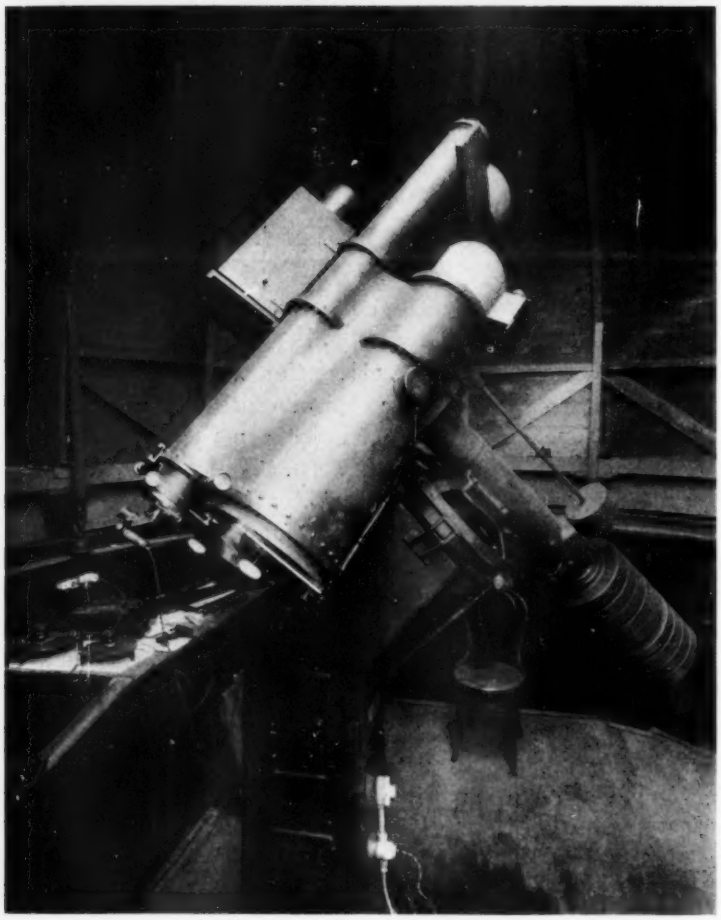
Not only has the telescope greatly increased the power of the human eye, but by the aid of the photographic plate used in connection with the telescope, it has been possible to make wonderful records of objects in the sky that have never been seen. By making long time-exposures it is possible to photograph stars much too faint to be seen with the most powerful telescopes; so, too, with the extremely distant spiral nebulæ or island universes of outer space beyond the confines of our Milky Way galaxy; and so with faint nebulosity as that surrounding the Pleiades or as the so-called North American nebula in the constellation Cygnus. Exceedingly faint stars and nebulæ may be recorded on the photographic plate, because the effect of the light upon the sensitized silver is cumu-



Photograph from Monthly Evening Sky Map

ROYAL OBSERVATORY AT GREENWICH

This was built in 1675 for the advancement of navigation and nautical astronomy. The British and nearly all foreign geographers reckon longitude from its meridian. In time it is five hours later than New York



THE BRUCE PHOTOGRAPHIC TELESCOPE

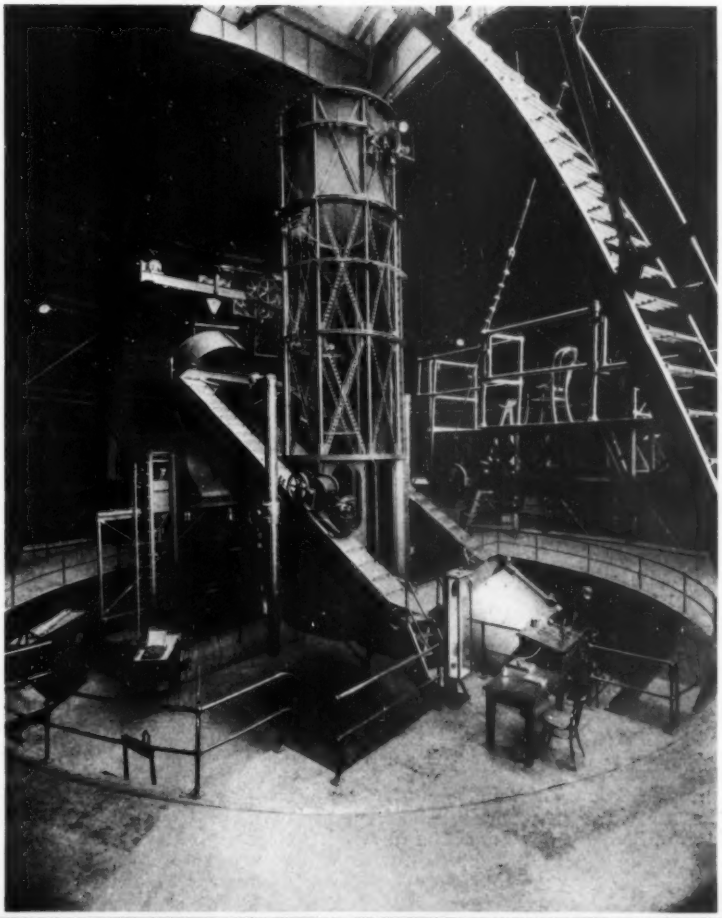
Since the rays of light which have most effect on the photographic plate are not the visible ones but the ultra-violet ones, the lens or mirror of a photographic telescope is figured correspondingly different than in a visual telescope. Photography is an extremely valuable adjunct of astronomy for several reasons, one important one being that objects entirely too faint to be seen will register on the photographic plate

Photograph from Yerkes Observatory

THE LARGEST TELESCOPE IN THE WORLD

The 100-inch Hooker telescope of the Mount Wilson Observatory near Pasadena, California, has been used by Dr. Edwin P. Hubble in his studies of the distant spiral nebulæ. In 1927 he was able to penetrate space to a distance of 140,000,000 light-years, and in 1929 he announced that the frontiers of space were 200,000,000 light years away. With this huge reflector one could see a candle at 5,000 miles, and an arc light on the moon

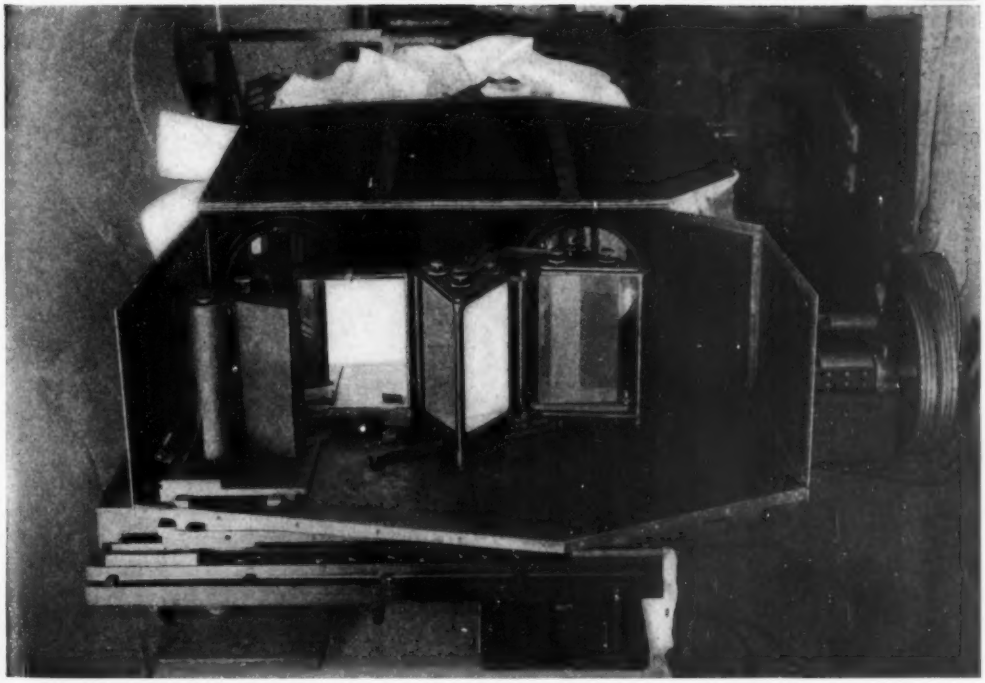
Photograph from Mt. Wilson Observatory



SPECTROHELIOGRAPH

This remarkable instrument was invented in 1890, independently by Hale and Deslandres. By means of this apparatus, the solar prominences may be photographed on any clear day. Great advances have been made in the study of the prominences and in the entire outer region of the sun, with the spectroheliograph

Photograph from Mt. Wilson Observatory



Photograph by Clyde Fisher

TWO LEADING AMERICAN ASTRONOMERS

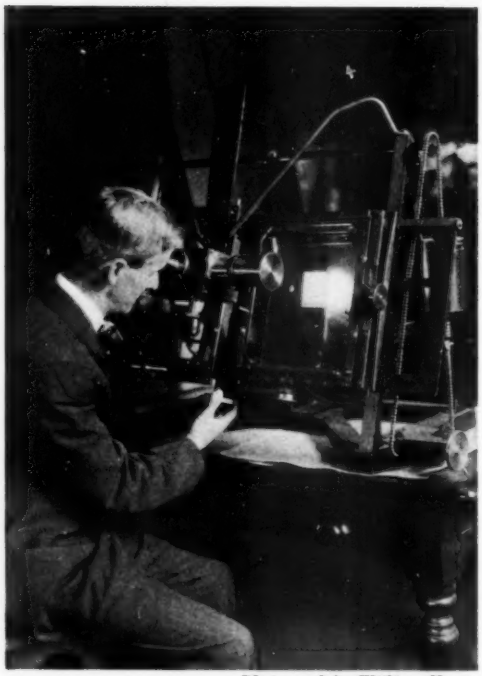
Dr. E. W. Brown, of Yale University, president of the American Astronomical Society, and Dr. Harlow Shapley, director of the Harvard College Observatory

lative and is piled up during a time-exposure, while in seeing, the effect of light on the human eye is dissipated constantly and does not build up, an image lasting on the retina only a fraction of a second. Since the rays of light which affect the photographic plate most are not those of greatest visibility, but rather those of the ultra-violet end of the spectrum, the photographic telescope is so made that these rays will be brought to a focus and utilized.

Since the formulation of the principles of spectrum analysis by Kirchoff, about seventy years ago, the spectroscope has contributed more to the science of astronomy than has any other instrument. Of course, it is true that the spectroscope is usually used in connection with a telescope. The principle of the spectroscope is that light, upon passing through a prism, is bent out of its course according to its wave-length,—that is, the red light is bent least and violet light is bent most. Thus white light may be dispersed or separated into the colors of the rainbow by being passed through a triangular prism. A similar result may be obtained by allowing light to be reflected from a grating upon which very fine lines have been ruled very close together,—several thousand to the inch.

Kirchoff found that there were three kinds of spectra, namely:

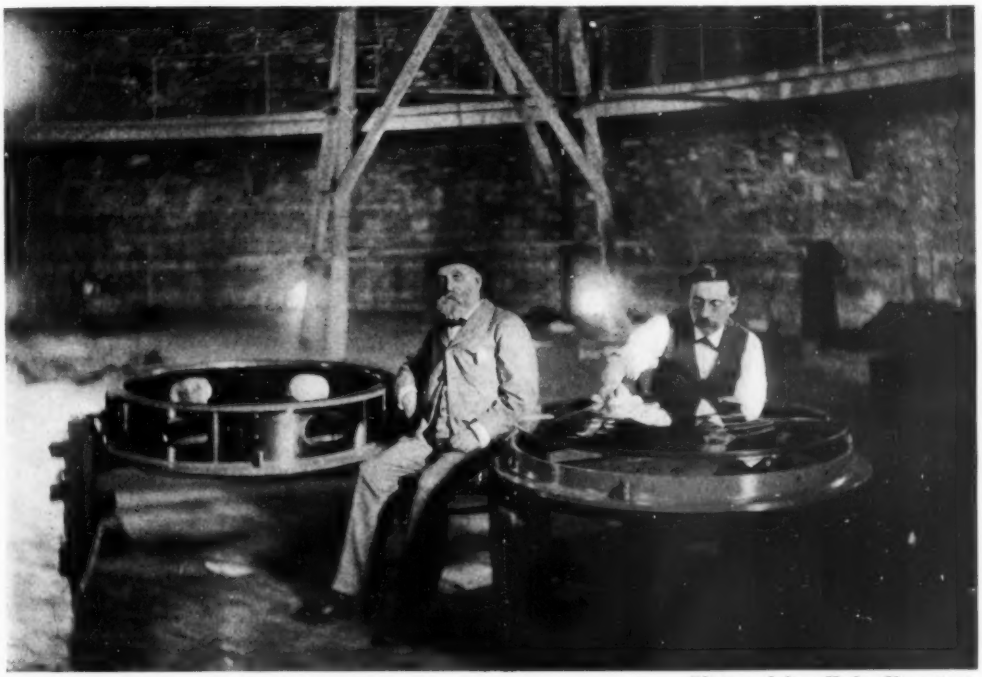
1. *Continuous spectra,* produced by incandescent solids or liquids or gas under high pressure.



Photograph by William Henry

BLINK MICROSCOPE

Dr. Leon Campbell, astronomer of Harvard College Observatory, is using this instrument to detect proper motions of the stars. Two photographic plates of the same field, made, say, ten or twenty years apart, are viewed alternately at rapid intervals through microscopes with the same eye-piece. When the plates are properly adjusted, the images of most of the stars appear fixed when the change is made, while those stars which have moved seem to jump, or blink



Photograph from Yerkes Observatory

ALVAN CLARK AND CARL LUNDIN

Alvan Clark and his assistant, Carl Lundin, with the 40-inch objective of the Yerkes telescope, which they had ground and figured

2. *Bright line* or *gaseous spectra*, produced by an incandescent gas or vapor, under moderate or especially low pressure.

3. *Dark line* or *absorption spectra*, produced through a medium capable of absorbing a portion of the rays.

In accordance with the third of these, Kirchoff explained the Fraunhofer lines of the sun's spectrum, which had been a mystery since their discovery.

By the use of the spectroscope, the physical state of stars, nebulæ, and the so-called "spiral nebulæ" was determined. Thus the great nebula in Orion was proven to be gaseous, and the great nebula in Andromeda was proven not gaseous.

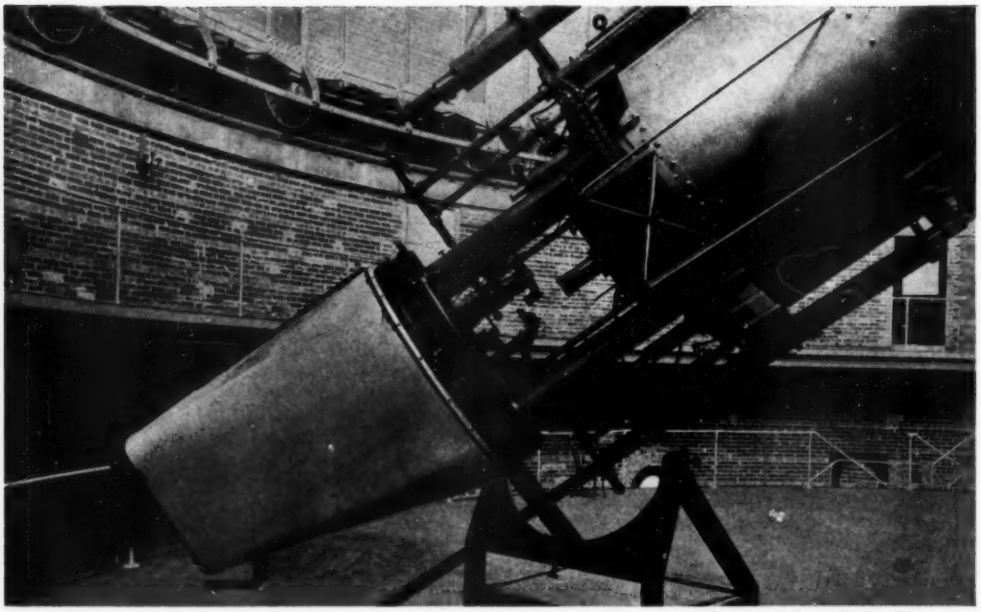
Since each of the chemical elements known on the earth, when incandescent, produces a certain line or series of lines that is different from that of every other element, it was found possible to analyze chemical substances in a qualitative way, and this method is sometimes useful in determinative mineralogy.

Kirchoff, and later Rowland of Johns Hopkins University, extended the method of spectrum analysis to the sun. Up to the present time, forty-nine, or more than half of the ninety elements known on the earth, have been proved to exist in the sun's atmosphere by the spectroscope.

In fact, one of these elements, helium, was discovered on the sun years before it was found on the earth. It was first recognized on the sun in the flash spectrum at the total eclipse of 1868, and it was named from the Greek word for *sun*. Not until 1895 was it discovered by Ramsay on the earth; and now it is found in sufficient quantities to make practicable its use in dirigibles.

Spectrum analysis has also been applied to other stars than the sun, to comets, and to nebulæ.

Recently it has been found possible to



Photograph from Yerkes Observatory

SPECTROGRAPH

When a spectroscope is arranged for photographing the spectrum, the instrument is known as a spectrograph and the photograph is known as a spectrogram. When photographing the spectrum of a star, an astronomer must be at the telescope constantly during the long time-exposure to keep the image of the star exactly in the same place, the motion produced by the driving-clock not being accurate enough

Photograph by Clyde Fisher

GALILEO'S TELESCOPES

Galileo made the first astronomical telescope in 1610. These telescopes are in the Museum of Physics in Florence. In the center of the old ivory mounting of the stand is the object-glass,—now cracked, but preserved as a historical relic,—through which Galileo discovered the moons of Jupiter

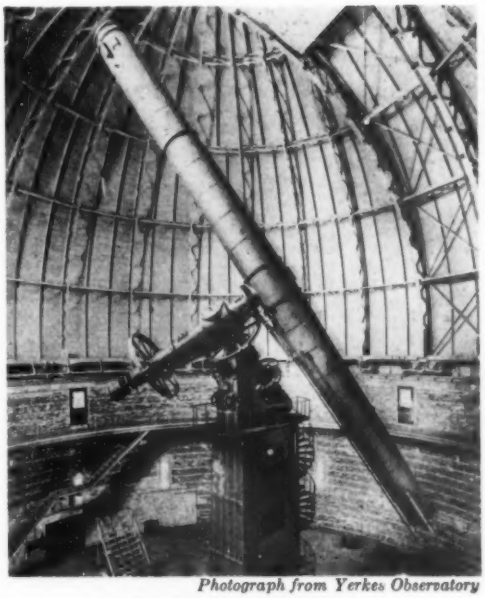
determine in a rough way the relative abundance of the elements in the sun which give rise to the Fraunhofer lines. Studies in the width and blackness of these lines has made possible some determination of the quantitative analysis of the sun.

A great deal has been learned about the movements of heavenly bodies by means of the spectroscope. If a body is moving toward us, more waves of light strike the spectroscope per unit time, and this causes a shifting of the lines toward the violet end of the spectrum. If a body is moving away from us, less light-waves strike the spectroscope per unit time, and this causes a shifting of the lines toward the red end of the spectrum. This shifting of the lines in the spectrum makes it possible to determine whether a star or other body is approaching or receding, and how fast. By an application of the same principle (Doppler effect), revolving binary stars are discovered, and the sun's rotation on its axis can be proved.

This brief discussion does not give an adequate notion of the present uses of the spectroscope, and astronomers feel that the possibilities of this instrument have not yet been reached.

When the spectroscope is used in photography, it is known as a spectrograph, and a remarkable instrument involving the principle of the spectrograph, invented independently by Hale and Deslandres, is known as the spectroheliograph. By means of this, the solar prominences may be photographed on any clear day. Formerly this was possible only at a total eclipse of the sun.

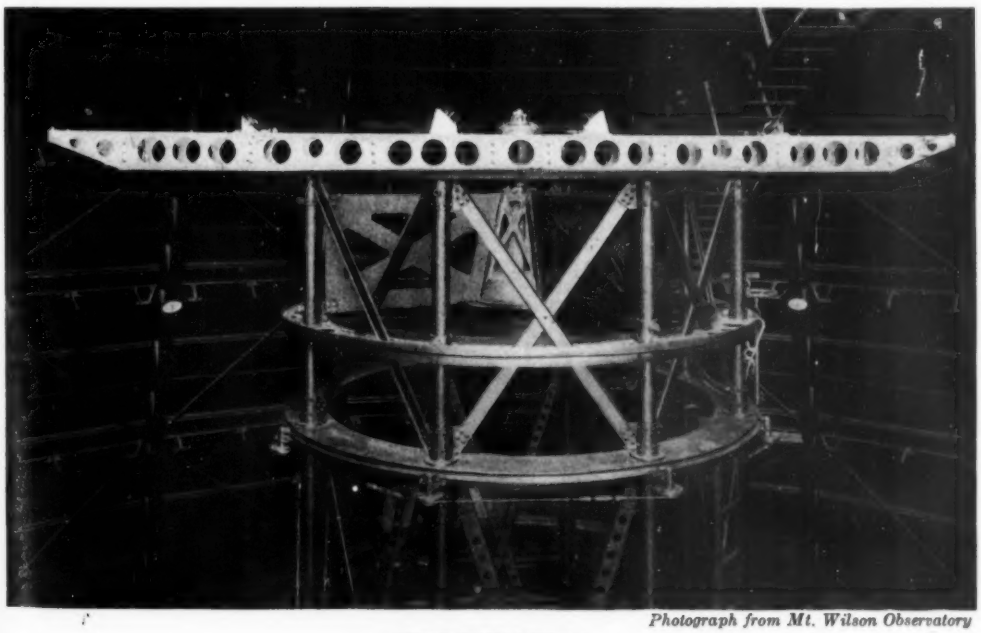
The interferometer, invented by Michelson, was used with the 100-inch Hooker reflecting telescope at Mt. Wilson Observatory in measuring the diameters of stars, and it is the only instrument by which this can be done. The first one measured was Betelgeuse, the reddish star in the right shoulder of Orion, the mighty hunter, and this was less than ten years



Photograph from Yerkes Observatory

YERKES TELESCOPE

Designed and built by Warner and Swasey, and exhibited at the World's Fair in Chicago in 1893, before being installed at the Yerkes Observatory. The object-glass, 40 inches in diameter, was ground by Alvan Clark and Sons. When built, this was and still is, the largest refracting telescope in the world. The focal length is 62 feet



Photograph from Mt. Wilson Observatory

INTERFEROMETER

With this twenty-foot beam interferometer it is possible to measure the angle subtended by a star's disk to within one-thousandth of a second of arc, "an angle about equal to that which the head of an ordinary pin at New York would fill as observed from the distance of Boston or Washington." A fifty-foot beam interferometer is now being built at Mt. Wilson

ago. The largest star so far measured is Antares, the reddish first-magnitude star in Scorpio. Its diameter is much greater than that of the orbit of Mars.

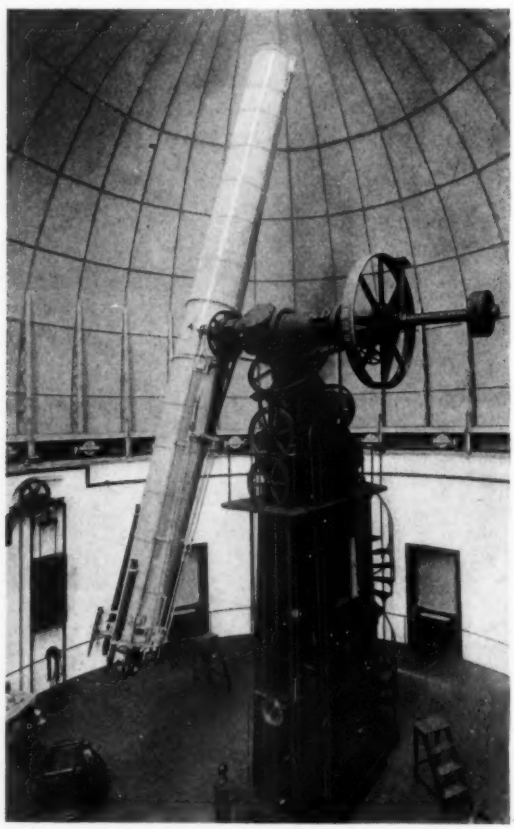
The photo-electric cell, developed by Stebbins and Rosing, makes it possible to measure the magnitudes of stars with great accuracy,—a very important advance in the study of variable stars.

The astronomer's workshop is the observatory with its domes for the telescopes, but besides these there are many other interesting and useful tools which can merely be mentioned in this brief article. The meridian circle for getting time from the stars, the chronograph for recording time, clocks and chronometers for keeping time from day to day, the photometer for measuring light, the bolometer for measuring heat, the thermocouple used to measure heat of stars and planets, the blink microscope used in detecting proper motions of the stars and also in detecting changes in brightness, the stereo-comparator used in conjunction with the blink-microscope, the spectro-comparator used in comparing spectra, the astro-camera which photographs with ultra-violet light, and the filar micrometer used in measuring very small angles in work with double stars, asteroids, etc.,—these are a few of the tools used in the astronomer's workshop.

O rich and various man, thou palace of sight and sound, carrying in thy senses the morning and the evening and the unfathomable galaxy, in thy brain the geometry of the city of God, in thy heart the bower of love and the realms of right and wrong.

—EMERSON.

Photograph from the U. S. Naval Observatory



THE 26-INCH TELESCOPE OF THE UNITED STATES NAVAL OBSERVATORY WHEN BUILT, WAS THE LARGEST REFRACTING TELESCOPE IN THE WORLD. SOON AFTER, ONE OF EQUAL SIZE WAS BUILT FOR THE UNIVERSITY OF VIRGINIA. LATER THESE WERE SURPASSED IN SIZE, FIRST BY THE LICK 36-INCH AND THEN BY THE YERKES 40-INCH. WITH THIS TELESCOPE THE MOONS OF MARS WERE DISCOVERED AT A FAVORABLE OPPOSITION IN 1877 BY THE ELDER ASAPH HALL

Base camp of the expedition at the foot of Ansha Mountain

IN QUEST OF THE QUEEN OF SHEBA'S ANTELOPE

PART II

Continuation of the Adventures of the Expedition in Search of the Abyssinian Nyala —The Home of the Antelope Is Finally Located and Specimens are Obtained

By GERTRUDE SANFORD AND SIDNEY LEGENDRE

Photographs by Gertrude Sanford and T. Donald Carter

OUR way led through a forest of broad-spreading trees, with great branches on which grew crimson puff balls. Emerging from the forest, we crossed a green dale, and then once more the trees closed about us in all their beauty. We camped at the foot of Ansha Mountain and from there prepared to hunt the surrounding hills. It was on the heath-crowned summits above the timber line that we hoped to secure the nyala, for here they grazed from dawn until dusk, and then descended into the protecting foliage of the forest below.

Rising before dawn, we began the arduous climb. The blackness changed to a dull gray. Gradually objects became distinguishable. We sat down to rest on a rock at the very top of one of the mountains. Slowly the curtain of fog and mist lifted, and we saw before us a valley on the other side of which rose the highest peak of Ansha. Scouring the surrounding slopes with our field glasses, we were unable to distinguish anything. Seated as we were, above the timber line, we were surrounded by giant tree heath that reached to our chests. Between clumps of this there were cleared spaces, and to one of these our boy, Bahano, suddenly pointed.

With the naked eye it was impossible to see anything, but through our glasses a magnificent nyala could be discerned slowly ascending the opposite slope. He did not appear frightened and apparently had not seen us. A wild but cautious dash down our mountain, across the valley,

A STREAM BETWEEN CHICKA AND ANSHA MOUNTAINS
Much of the trail between these two mountains was through the open, subtropical forest. Its scattered trees and bright-colored flowers gave the country a parklike aspect

up the opposite slope, around the peak in order that he should not get our wind, and we crept forward, rifles ready for instant use.

Raising my head above a bowlder, I looked. Miss Sanford, who had gone farther around, did the same. He was gone. Absolutely spirited away. It was impossible to pick up his tracks in that tangle of heath, and though we searched diligently, he was not to be found. Subsequently that day we saw several cows, but as a vow had been made by all that no shot should be fired unless at a bull, we did not stop. Mr. Carter and Morris LeGendre, who had hunted different peaks, reported having seen cows but no bulls.

For three days our luck remained unchanged. We no longer slept at our camp, but each person selected a mountain on which he hunted and slept. In this way we felt sure that sooner or later we would run that bull to earth. It was our habit to meet at one person's cot each evening and report on the day's happenings. As a result of these meetings something happened that is amusing now but was tragic then. Sidney LeGendre and Mr. Carter had gone to Miss Sanford's peak for dinner. They delayed their departure until the sun had set and when they reached Sidney's peak and tried to find his bed, night had fallen, and with it the cold and mist of mountains 12,000 feet high. No trace of the blankets could be found; undoubtedly a nyala had wrapped himself in them and dozed off behind a rock! It was freezing, yet it was impossible for Sidney and Mr. Carter to find their way back. There was nothing to do but build a windbreak of heath, make a bed of the same material and draw up covers of heath. Those who have slept out of doors without cover when the thermometer is well below freezing, and a

small gale runs down one's collar and out of one's shoes, will appreciate the situation.

The following evening Morris LeGendre shot a nyala bull and Miss Sanford secured two does. We hunted this range for several days, but without further success. A native told us of Kaka Mountain, where he said nyalas were to be found in greater numbers. This was not very difficult to believe, for after ten days' hard hunting we had secured only three.

Morris and Miss Sanford set out for Kaka with a tent and two natives, while Mr. Carter and Sidney returned to the main camp, Mr. Carter to prepare the skins and Sidney to doctor an infected hand. They had been there two days when the mule boy Gabra Walda arrived, panting and blowing, declaring that he had traveled until the very gazelles stopped to admire his speed. He brought no less news than that Morris had shot a nyala whose horns measured from horizon to horizon! We had fallen into the habit of admiring a fine lie and the boy received a drink of cognac as a prize.

However, Sidney and Mr. Carter made plans to join Miss Sanford and Morris at once.

There were no regrets on leaving, for Omar, the cook, had prepared concoctions which had not only the appearance of miracles, but tasted like the unknown. Only the evening before, the meat he had served made Sidney and Carter feel sure that some rare animal had come into the camp and fallen prey to his knife. Upon being questioned, he assured them it was goat that they were eating. Then the great secret came out.

"What did you cook it with?" they asked.

T. DONALD CARTER, MORRIS LEGENDRE, GERTRUDE SANFORD, AND SIDNEY LEGENDRE, WITH A NYALA BULL

This bull is destined to be the main feature of the Nyala Group in the new African Hall

ANSHA MOUNTAIN

The slopes of Ansha Mountain are forest clad up to an altitude of 9000 feet. Above this, tree heath is the most common form of vegetation

THE HEATH-COVERED SLOPES ON THE SUMMIT OF KAKA MOUNTAIN

It was in this type of country that nyalas were found. The animals spend the night on the forested slopes, but by morning they are in the open country

ABOVE TIMBER LINE

Each one of the four members of the party selected one of the four peaks as a bivouac in order to be on the summit at dawn to observe the nyala

CAMP ON KAKA MOUNTAIN

Camp was pitched in the tree heath, about a third of the way up the mountain-side. The summit of this mountain rises over 12,000 feet, and every morning ice was found in the water buckets

Back to his kitchen he went and emerged with a tin can. This he held forth for their admiring gaze. True, it was the same color as those containing "Wesson's Cooking Oil," but this one bore in great letters the word "Flytox." Moral—never leave two cans of the same color in an Abyssinian kitchen!

Early the next morning Carter and Sidney started for Kaka and after a day's trek, arrived with the salt and other essentials for preparing the nyala skin, which proved a fine large specimen, with horns measuring more than 40 inches. Now that we were in the right country, nyala followed nyala. Kaka was an easier mountain to climb. The slopes were not as precipitous as those of Ansha, and our camp, perched halfway up, saved a great deal of climbing. Morris LeGendre secured six bulls, Miss Sanford a bull and five cows and two fawns. Unfortunately, before we could get to the fawns to skin them they had been devoured by hyenas.

Mr. Carter and Sidney LeGendre each secured a bull, but without doubt, the most thrilling of all of the hunts was when the first big bull was shot. He was sighted a little after sunrise, and was followed all day, yet, although he was always kept in sight, he was never close enough for a shot. At sunset he seemed to disappear altogether. Suddenly, just as the party was about to return to camp defeated, he appeared silhouetted against the sky. The range was rather long and the light practically gone, but as it was their last chance, they decided to shoot. The first shot, a lucky one, dropped him in his tracks.

In one day Mr. Carter had six animals to skin out and care for. The natives helping him were practically useless.

THE HEAD OF A NYALA BULL

In general appearance the nyala reminds one of the greater kudu, and it was not until 1910 that it was described as a different animal. The natives still call them both "agarzin"

Doing very little, they nevertheless managed to do it carelessly, so that he was forced to go over everything they touched. Often he worked a day and night without stopping, and it is due to his untiring efforts and skill that we were able to bring back to the Museum the skin of every animal we shot.

The group was now complete. The skins were packed on the backs of the mules and we returned to our main camp at Chika. Our boys were only too delighted, for the food had given out long ago, and nyala meat, though delicious, becomes a bit tiresome as a steady diet. We considered it advisable to send the skins straight to Addis and from there ship them to the Museum immediately. To do this, it was necessaryto split our party. Sidney LeGendre took the skins, nineteen of the mules and eleven men to Addis, while the others continued on to Sidamo.

THE POWER IN SIDAMO

Desjasmatch Beru is one of the most powerful of the Desjasmatches in southern Abyssinia. He is an ardent admirer of Napoleon Bonaparte, and his most cherished possession, upon which his hand rests, is a volume on the life of the distinguished soldier

The division of our caravan was an occasion for many tears. The boys all wept on one another's shoulders and the half of the caravan continuing to Sidamo sent messages to their families by those returning to Addis. After one-half had kissed the other half good-bye and handshakings were finally terminated, Morris LeGendre, Carter, and Miss Sanford, with thirty-nine of the strongest mules and thirty of the best men, set off on the trail leading to the south, the Sidamo country.

They camped once more on the Ansha Mountain, not far from our old nyala camp, and in a bamboo forest on the slope of the neighboring mountain, Carter was able to collect half a dozen fine *Colobus* monkeys.

For the next two weeks they caravaned south, averaging about five to six hours' trek a day, which proved the most their underfed mules could do. Providing hay and finding good grazing was not always an easy task. Water was scarce and usually very bad. On many occasions, if it had not been for generous gifts of corn from friendly chiefs, the mules would have fared very badly.

CHIEF OF POLICE OF SODDU IN ROYAL UNIFORM
This costume, given to men of distinction by the King, consists of a scarlet jacket with a long blue velvet collar trimmed with gold braid. The headdress is made from the mane of a lion

The route took them off the high Arussi plateau down many thousand feet through a primeval forest into the valleys below. They crossed hot plains and deserts and climbed again into the mountains, often losing themselves and taking their caravan many miles off the route. It seemed that every time they relied on a native guide, they invariably ended at some spot well off the line. Later they discovered the reason. Whenever the expedition was in the vicinity of a market, the boys would bribe the guide to conduct it there, so that they could all drink tala, buy food, and stop work. The party soon caught on to the scheme and no longer employed a guide. They would study the map every evening and plan their route and, regardless of trails, cut straight across country on their own line, and almost always successfully.

Water was the one great difficulty, for though rivers were marked on the map, they very often proved a disappointment, for so many times they were dry when found.

As soon as tents were pitched and mules tethered in the center of the camp to secure their safety from shiftas and hyenas, the party would hunt. Carter secured many species of mice with his trap lines and Morris and Miss Sanford collected a dozen more blue-winged geese, obtained at the same altitude, 8000 feet. Aside from shooting meat for the camp, such as reed buck and oribi, no big game was collected for the Museum in the Sidamo country.

On reaching the capital at Sidamo, Agar Salaam, the party sent a note by their interpreter to the chief of this country, Desjasmatch Beru. They camped by a small stream just outside the town and before sundown rode to a Greek store in the village to replenish supplies of sugar, rice, coffee, and tobacco. Here they found two Greeks poring over a letter, and looking very excited. They were writing down words as they read. Miss Sanford recognized the letter as one the party had sent to the Desjasmatch earlier in the day,

so she asked in French whether she could interpret the letter from English to French for them. As it turned out, it was a lucky thing they happened in when they did, for these unfortunate little Greeks had translated the note which said, "We are a hunting party representing the American Museum of Natural History, traveling with a scientist in the party."—to the effect that "We were a party of missionaries, traveling with a horse doctor."

As the Desjasmatch disliked missionaries, they would have been shown little hospitality. They hastened to make their character clear to these little Greeks, who were doing their best to act as interpreters for the Desjasmatch, who had none of his own.

That evening servants poured into camp with presents of bread and wine for the expedition, and grain for the tired mules, and his messenger brought an invitation to lunch with the Desjasmatch on the morrow.

A more gracious welcome one could not wish. The boys had washed their white tunics for the occasion and were spotlessly clean. Their shamas were thrown over one shoulder, a Springfield rifle over the other. They walked two abreast before and behind as the party marched through the main street of the town to lunch at the Gebbi. The King's mule and the two old white horses had been washed and scrubbed in the stream for hours, preparatory to this, but in spite of all efforts, these animals looked more like replicas of Don Quixote's old horse than anything else.

As the guests approached the Gebbi, the Desjasmatch's guard met them and escorted them through the portals and into the courtyard, where they dismounted. These soldiers were in ludicrous military array, some shouldered rifles on their right shoulder, some on their left. Some wore felt hats and some did not, but this escort was a gesture of courtesy. And for the rest of the day the guard never left the guests.

The Desjasmatch greeted the party on

ANOTHER PHOTOGRAPH OF THE CHIEF OF POLICE OF SODDU
When the expedition party broke the law by shooting after sundown, they found that they were able to appease the Chief of Police only by photographing him. After they had taken fourteen pictures of him, in almost as many costumes, he became friendly

THE POLICE FORCE OF SODDU
The Chief is here resplendent in the royal costume of the country. This was by far the most pretentious of his many uniforms

the steps of his round wooden palace and served them vermouth under a canopy of scarlet cloth which had been placed to the left of the entrance. They were then escorted into the building and into a very large room with a high ceiling, supported by many tall, red plush pillars. In the center of the room was a long table, laden with dishes, glasses, and all kinds of wine. The interpreter told them that the Desjasmatch apologized that he could not lunch with them, as it was his fast, but would join them for coffee. He hoped they would enjoy their meal, and added in French, *Bon appetit*, and left.

Carter, Morris, Miss Sanford, and a clever little Armenian, who was the Desjasmatch's right-hand man, were the guests at lunch, and as they ate the native dishes, the Armenian would explain what each one was made of and how it was cooked. To describe what they ate would be impossible, for they counted thirteen courses altogether, and at least six different kinds of wine. It is needless to say they felt ill when they left the Gebbi, for they had been literally forced to taste every dish, which in reality meant eating all of it, for each was delicious. Every kind of native sauce with its hot peppers was served, and even the servants would beg them to eat some more. They had tedge of the very finest brew and chicken cooked in some green native leaf which was a masterpiece. After sampling every type of Abyssinian dish, they all felt they had desperately overeaten.

The Desjasmatch Beru joined them for coffee and liqueurs and showed them books on the life of Napoleon, of whom he seemed very fond. They asked if they might take his photograph, and he was delighted and pleased to dress up in his royal robes of blue velvet and gold, with a great golden cross on his chest. He showed much interest in the expedition

and seemed above all impressed that a woman should like to do that type of thing, particularly shooting. He always came back to the subject, it surprised him so much.

When it came time to say good-bye, the boys were nowhere to be found. They, too, had been royally wined and dined and evidently too much tala had taken its toll, for two of the boys were already in prison, due to their unruly behavior, and the others were too drunk to appear.

That evening more gifts were brought into camp from the Desjasmatch. A big fat bullock, several sheep, more injura bread, tedge and tala, and even a couple of Toto monkeys. Miss Sanford had expressed a wish for a monkey and now they arrived from all over, big ones and little ones, and baboons as well.

It was the custom to give a Marie Therese dollar for every gift brought into camp by a servant from the Gebbi. The consequence was that the little native boys of the village were collecting monkeys from the bamboo forest near by and bringing them into camp, making a dollar clear profit. The party eventually realized this and were satisfied not to increase their menagerie beyond three baboons, three Toto monkeys, and one reed buck doe. The doe was the first to be turned into a specimen, as she would not follow the caravan, but always became hopelessly entangled at the end of her rope when passing mules and natives. The baboons and monkeys went next, for they bit every one rather often and broke away so many times from the top of the mule packs to which they were tied, that stopping each time to catch them slowed up the caravan.

The route from Agar-Salaam to Soddu led across a vast desert, where little water was to be found and the days' marches had to be long ones, ten to twelve hours. The heat was terrific and one of the old white horses had to be shot, as it could no

CHIEF OF POLICE OF SODDU IN POLICE UNIFORM
A section of the Soddu police force which attempted to arrest the party for shooting after sundown

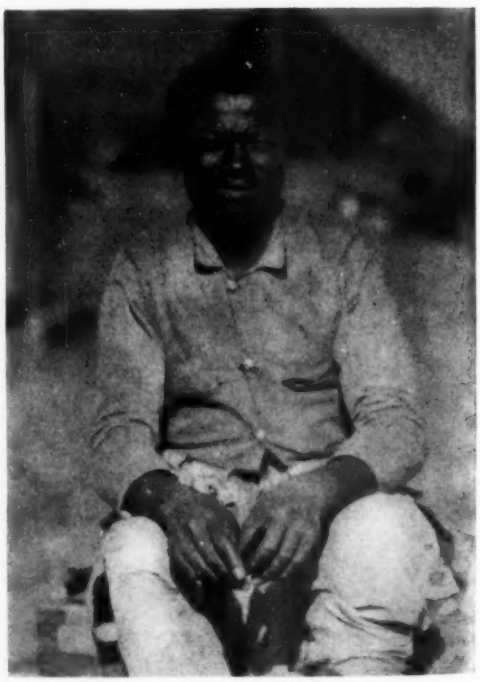
BUSHERA
Although at first hired as cook's helper, Bushera, by his willingness and cheerful disposition, was soon advanced to personal boy

longer continue. Camp was made along the Bolati River in the midst of a desert, shadeless, thorn-bush country, with the hope of securing new specimens, but only the usual animals prevailed, namely the oribi and reed buck.

Heat, dust, sand, volcanic rock, baths in muddy streams, bad drinking water,—this was the general program of the ten-day trek from the Sidamo country into Waloma country and eventually to Soddu, where Sidney Le Gendre joined the party. He had arrived from Addis with a fresh supply of vegetables and milk, which were very acceptable.

It was at Soddu that we ran afoul of one of the curious laws of the country. A hyena, which had been running the scales in a deep bass voice, suddenly gave up singing as a none too lucrative profession and entered our kitchen. Mr. Carter came to the rescue and shot the beast. In half an hour our camp was surrounded by soldiers, who stood with ready rifles prepared for the great attack. They remained there all night, probably, we thought, to protect us against future four-footed raiders. But such was not their purpose, for in the morning the Chief of Police appeared with another army behind his back. Whom had we killed? Had we buried our victim or simply eaten him? Carter produced the hyena skin and the army was recalled. Between cognacs his Majesty's representative told us that whenever any one fired a shot within the limits of a village, he must produce the thing killed, otherwise he was considered guilty of having killed a man and must forthwith be hanged. Moral: If you are a bad shot, keep a couple of old skins handy.

From our camp we could see Lake



HEILIE
Heilie originated from one of the more southern provinces and was undoubtedly brought to Addis Ababa as a slave

PRESENT ARMS!
After a little practice, our boys became quite expert in executing the "Manual of Arms"

Abaya in the distance. Only half a day's journey away, it should certainly prove worth our while, for we were told that its shores abounded with game. From a distance this lake is beautiful, but on closer inspection it is dreadful. The water is almost black, so filthy is it, and great rock cliffs from whose sides steam gushes, rise straight up out of this disgusting mixture. Behind the cliffs there is a valley, dry, arid, covered with thorn trees, and beyond is another ridge, lava-strewn, its slopes covered with tangled creepers and coarse grass.

At one end of the lake a great open space, half swamp, half pasture land, provides grazing for the native cattle. It was here, on a raised spot above the swamp, that we pitched our camp. The heat was beyond belief. It burned through our double fly, turned all food into a nauseating mess, and left us listless and limp. The mules, driven wild by the flies, daily grew thinner. At night the mosquitoes descended upon us in legions. Our nets were mere parade grounds on which they loosened their limbs before beginning their evening meal. And yet it was here on the shores of this infernal lake that we found more game than at any other place. Specimens were secured of reed buck, water buck, bush-buck, tora, kudu, wart hog, and several species of birds. Both Morris and Sidney LeGendre thought they saw Prince Ruspoli's turacou, *Turacus ruspolii*, a bird known only from the type specimen which was supposedly collected at this lake, but though we scoured the country-side for a week, we did not obtain one.

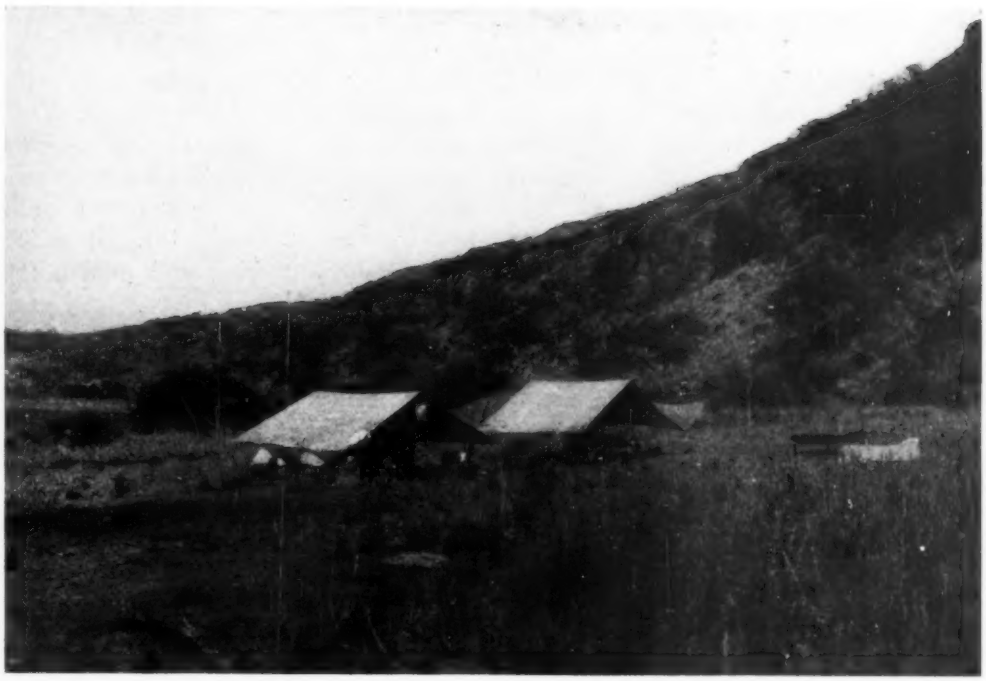
Our men and mules were faring so badly that we thought it wiser to return to our main camp at Soddu. The day after our arrival smallpox broke out in camp, and unfortunately the victim slept in the same tent as did our cook and dish-washer. Burning the tent and blankets, we shook the dust of Soddu from our feet and set

LAKE ABAYA

One night, while the expedition was encamped on the shore of this lake, known also as Lake Margureta, a large herd of hippopotami came into camp to graze along with the mules 174

DIFFICULTIES IN TRAVEL

In crossing the swamp at Lake Abaya the mules became bogged, and only after their loads had been removed and the tents spread for them to tread upon, was it possible to lead them across



CAMP AT LAKE ABAYA

One of the most interesting of the expedition camps. Daily, baboons were seen on the rocks above. A hot spring afforded excellent bathing

BOYS CLEANING GUNS

On account of the rains, it was necessary for the boys to spend all of their spare time cleaning the firearms

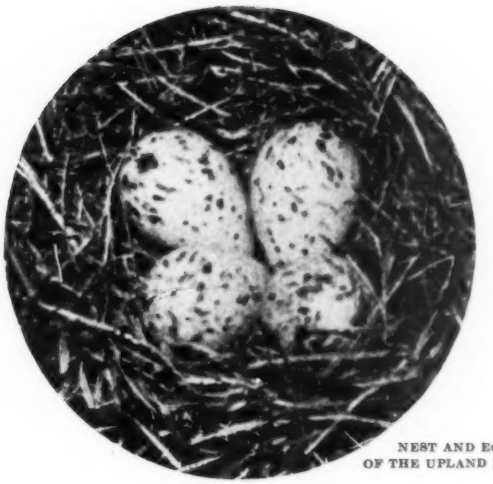
our faces toward the Omo River, intending to cross it and explore the Kaffa forest on the farther side and then gradually work our way out to the Barre River and thus down into the Nile.

At this time all of our men who had accompanied us to Lake Abaya were stricken with malaria. There is nothing more pitiful than an Abyssinian when he is ill. He is absolutely helpless and merely lies and moans. To make matters worse, the rains set in before their time, catching us in the Kambatta Mountains. The trails became slippery slides, which afforded no foothold for the mules. In many places it was necessary to dig fresh dirt from the side of the hill and strew it upon the path before they were able to continue. It was disappointing work. Each night we could look back and see where our previous camp had been. Our men were now completely exhausted. It was necessary to place the weakest ones upon our own mules. The trails became worse; in fact they were no longer trails, but mountain torrents through which one splashed, pushing and pulling the worn out animals.

The banks of the Omo are precipitous. It was necessary to descend 2000 feet, cross a river in flood, and then climb the opposite bank. Our men were tired, dispirited by the fever and the rains, the mules were giving out, the equipment was soaked, with never an opportunity to dry. We had secured the nyalas, the object of our expedition, besides many other specimens, so, after a brief consultation, we turned our horses' heads toward the north and started on the homeward trail.

CAMP ON THE HAWASH RIVER

Two days before reaching Addis Ababa, the expedition again pitched camp on the Hawash River, but this time a few miles farther to the west from the camp site of four months before



NEST AND EGGS
OF THE UPLAND PLOVER

THE UPLAND PLOVER

A Game Bird Once Common on the High, Dry Prairies of the Northern States, Which Seems to be Adapting Itself to Changed Conditions and Now Is Nesting in Cultivated Fields

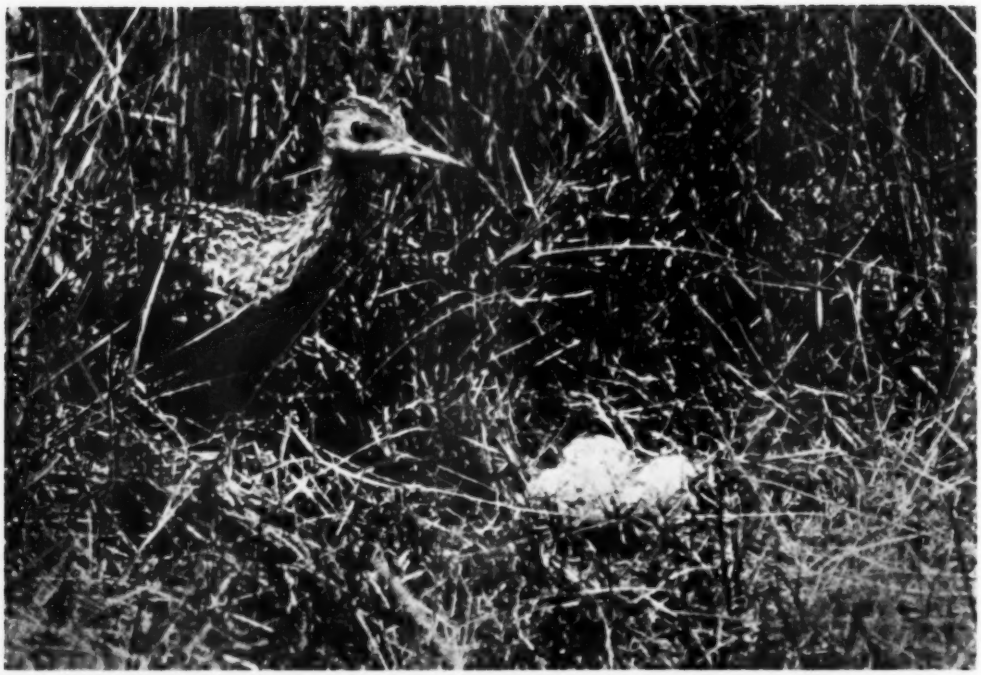
By ALFRED M. BAILEY
Director, Chicago Academy of Sciences

THE fall migration along the Louisiana Gulf Coast was under way, and many shore birds were congregated upon the mud flats of the marshes bordering the little oak ridge called Chenier au Tigre. One evening, after the sun had dropped below the horizon, we were plodding wearily through the loose sand of the beach, homeward bound; we had been hunting inland and were tired from continuous exertion, so, when we stumbled over a bit of driftwood, we stopped to rest.

A light on-shore wind rippled the waves of the Gulf against the sand, and the calls of sea birds came from across the open water. Great-bodied pelicans drifted near—vague masses in the blackness, and disappeared without a sound to tell of their passing, and sandpipers, running along the water's edge, suddenly realizing that they were within a few feet of us, took wing with startled cries. Many bird wayfarers, delayed on their feeding grounds, were on their way to their evening roosts, and there were many strange calls coming from the black void about. Suddenly, from high overhead in the starlit sky came a low trill which was repeated at intervals from other parts of the heavens. Then came other gentle, prolonged notes,—quiet, and yet far-carrying, and as the birds overhead passed on southward across the waters of the Gulf of Mexico, we heard additional voices now and then, as though the wayfarers were talking to those which had gone ahead,—and were guiding others following.

My companion was a native of the marshlands. When he heard the calls from above, he grasped my arm as though to keep me silent, and then he breathed—"Papabotte, papabotte."

It was my first acquaintance with the upland plover,—called "papabotte" by the inhabitants of the Louisiana lowlands; it was a rather unsatisfactory meeting,



THE UPLAND PLOVER APPROACHED HER NEST CAUTIOUSLY
For two hours she had circled about the blind, creeping slowly through the tangle of grass, with her large brown eyes constantly upon the photographic shelter

SHE LEFT THE PROTECTION OF THE LONG PRAIRIE GRASS
With neck outstretched, she walked so slowly that she seemed to be dragging heavy weights upon her feet. At last she turned directly toward the nest

THE PLOVER EYED THE BLIND

The bird stepped carefully over her eggs, and paused with her eye on the blind. She half crouched upon the nest, and then stood motionless for a full minute to satisfy herself that all was well

TURNING HER EGGS

Apparently oblivious to the whirring of the motion picture machine, the plover slowly thrust her beak downward among her eggs, and rolled them about to suit her fancy

to be sure, except that I always remember that quiet evening when I think of birds starting on the mysterious air voyages of their seasonal migrations. My papabottes were blazing their air trail across the broad stretches of the Gulf to their wintering grounds in the vast Argentine savannahs, and I felt better acquainted with them—and more interested in them than in many species which I knew from daily observation.

Since that night along the Gulf Coast, I have always wished to meet the upland plover on its nesting ground and to photograph one upon her eggs. The upland plovers were once exceedingly common birds of the high, dry prairies of the northern states, from the Atlantic to the foothills of the Rockies. They were considered as excellent game birds, and were killed on their breeding grounds and in migration, so it is not strange that these fine "shore birds" should be near extinction. They are no longer found in many parts of their former range, and even where they do occur, they are not common. In the past few years, however, the plovers seem to be adapting themselves to changed conditions, and nest in cultivated fields when unbroken prairies are no longer available.

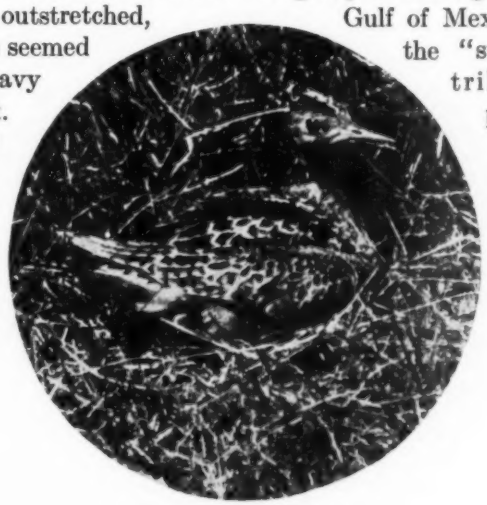
My first nest of the upland plover was found in northeastern South Dakota, near the little village of Waubay. The country is rolling and broken, with bowlder-strewn prairies, and these birds are still found in numbers. We were making motion films of the animal life of the region for the Chicago Academy of Sciences, and had obtained the help of the people of the vicinity. Mr. Arthur Lundquist of Webster was particularly well informed, and offered to show me a nest of my old friend, the "papabotte." It was a blustery day in June, with storm clouds scudding across the Dakota sky; the wind blew a gale and the weeds and grasses waved and rippled like the waters of the lake. We crossed the rolling prairies to the edge of Bitter Lake and flushed our bird from its nest. The three large eggs were upon the ground, and were so well concealed in the parched grass that one could not see them from a few feet away; in fact, even though we knew we were within a short distance, we could not see the plover until she took wing.

The blind was erected, but the wind was blowing such a gale that I feared the plover would never return to her nest; the canvas waved and thrashed about so that I had to stand on the edge to keep it in place. The motion-picture machine was focused on the nest, more as a matter of habit than with the expectation of the bird returning, and we concealed ourselves. From the slit in the blind I watched the sea of prairie growths, and imagined every little brown object was my intended subject. And then—three feet from the nest a rounded head appeared and large brown eyes stared unblinkingly. For five minutes the bird remained motionless while we waited anxiously. Then, as suddenly as the bird had appeared, she disappeared from sight. A few moments later she approached the nest. The camera whirred and the blind thrashed madly with loud, snapping sounds, but in spite of the noise, the plover crawled upon her eggs. She was the most satisfactory subject I have ever photographed, for she was on her nest within fifteen minutes of the time we concealed ourselves in our photographic tent.

Fortune favored me the following season, for another set was found within a mile of my home. The prairie country near Chicago is fast being subdivided, but the few remaining plovers seem to be adapting themselves, and this nest was within twenty feet of a cement walk and only one hundred yards away from a golf course. The four eggs were well concealed in the long prairie grass, but we carefully removed the vegetation from in

front so that a clear view could be obtained. The nest was found on May 27, the set of four eggs being complete at that time. My experience with this plover was somewhat different from that with the Dakota bird. As she was so close to the sidewalk, and was accustomed to the passing cars, I expected she would break all records returning to her eggs. But not at all. My blind was erected at eight o'clock, and for two hours the old bird walked circles about me. She would stand motionless twenty feet away, eyeing the blind, and then suddenly disappear in the long grass. A few minutes later she would be on the other side, quietly looking things over. Then, occasionally, as though to vary the monotony, she would scold with a peculiar, rasping call; then she would take to wing and alight on a near-by telephone pole where, with upraised wings, she would utter her melodious, trilling call. It is a far-reaching, beautiful, characteristic note that is not to be mistaken for that of any other bird.

Time and patience are all that is required in bird photography, and I had the time, if not the patience. The plover finally settled to the ground and slowly approached the nest. She came from the thick grass with neck outstretched, walking so slowly she seemed to be dragging heavy weights upon her feet. Finally, she stood astride her eggs, still eyeing the blind, and, apparently satisfied that all was well, she turned her beak downward, inspected her eggs, and settled upon them.



She Settled Upon Her Eggs

The nest was under daily observation, for the period of incubation of this species had never been determined, and while I did not know how long the eggs had been in the nest at the time they were found, I felt it worth while to keep notes. Mr. A. C. Bent, in his *Life Histories of North American Birds*, states that the incubation period "is said to be seventeen days, but this needs confirmation."

The nest was visited every morning and evening from May 27 until the date of hatching, June 20. On the latter date I visited the nest in the morning, but not an egg was pipped; in the evening two eggs had hatched and two addled ones remained, but, although the anxious parents were flushed from the long prairie grass and their querulous calls showed that the young were near, I could not locate them. While I did not see these young, I believe there can be no doubt that the eggs were hatched, and so, it seems that the incubation period for this species is at least twenty-four days.

The prairies of South Dakota and suburban lots of western Chicago are a long way from the glistening waters of the Gulf of Mexico, but when I hear the "sweet, mellow, rolling trill" of the upland plover, I can close my eyes and visualize a dark, starlit night along the Gulf and the migrant hosts on their long trek southward across the unmarked skies.

The model of the whale shark, *Rhineodon typus*, in the American Museum

WHALE SHARK!

How a Specimen of the Greatest of Living Sharks, *Rhineodon typus*, Was Captured near Marathon, Florida, and How It Was Towed to Key West

By E. W. GUDGER

Bibliographer and Associate in Ichthyology, American Museum of Natural History

AND L. L. MOWBRAY

Director, Bermuda Aquarium

The largest, the rarest, the most characteristically marked, the most interesting, and in many ways the least known of the Elasmobranch or strap-gilled fishes, is the whale shark, Rhineodon typus. First discovered in Table Bay, Cape of Good Hope, by Andrew Smith in 1828, it is found in tropical and sub-tropical waters the world around. We have records more or less definite of about sixty specimens, about one half of which records were made by scientific men with data sufficiently detailed to add to our knowledge of this little known monster.

Four of these specimens have been taken on the coast of southern Florida. The first, a young fish only 18 feet long, came ashore on Ormond Beach in 1902. It was described by Mr. B. A. Bean of the U. S. National Museum, where its skin and jaws are now preserved. The second was captured in 1912 at Knight's Key by Mr. Charles T. Brooks of Cleveland, Ohio, and Capt. Charles Thompson of Miami, Florida. This specimen was 38 feet long and 18 feet in girth. The capture of this fish was put on record in 1913 by Dr. E. W. Gudger, one of the authors of this article, and in 1915 he published (Zoologica, Scientific Contributions New York Zoological Society, Vol. I, pp. 349–389, 14 figs.) a monographic article describing in detail the capture and the external appearance of this huge fish, and summarizing all the data from all the then known descriptions and notices of the whale shark. This was followed in 1918 by another article, by the same writer (Science, Vol. 48, pp. 622–627) bringing together additional notes on habits and distribution.

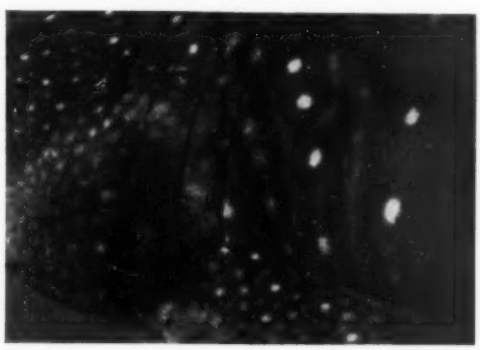
The third Florida specimen (31 feet long) was taken by Dr. H. Schlegel and others on June 10, 1919, in the Bay of Florida, near Man-of-War Key, some eight miles southeast of Cape Sable. Both of the authors of this article were then in New York, but word of its capture was received too late for them to have reached Florida City, where it was beached, in time to have saved any of the soft parts. The skin, however, was removed, and an effort was made by Mr. Arthur D. Lord to purchase it for presentation to the American Museum. A prohibitive price was set upon it, however, so this was not done. This skin has since gone to pieces.

The fourth Florida Rhineodon was taken early in June, 1923, near Marathon, 16 miles below Long Key, by Mr. Claude Nolan of Jacksonville, who was cruising in the Keys on a fishing trip with a party of friends in a houseboat, under the guidance of Capt. Newton Knowles of Miami, and it was examined by L. L. Mowbray for the American Museum. It is with this specimen that this article deals.—THE EDITORS.

ABOUT 10 o'clock on the morning of Saturday, June 9, 1923, while off Marathon, Florida, a party of anglers, of whom Mr. Claude Nolan was one, spied at the surface of the water about half a mile away a large object which looked like an overturned boat or some large piece of floating wreckage. Proceeding toward it, they presently saw that it was a gigantic fish. Cautiously approaching still nearer, the party found it to be a huge shark of the same kind as that caught eleven years previously in the same general locality by Mr. C. T. Brooks and Capt. Charles Thompson. After some discussion they decided to try to capture the monster.

The shark, being beautifully marked with vertical yellow bars separating vertical rows of yellow spots, was easily followed in the clear water, and the boat was able to approach the whale shark near enough for Captain Knowles to throw two harpoons into it. Pricked by these, the giant fish, which apparently had been asleep, awoke and lashed the waters into

foam, causing the boat to sheer off hastily out of reach of its waving pectoral fins and the threshing of the great tail, which later was found to measure 12 feet in vertical spread. However, the harpoons held in the two-inch-thick hide and the fish had no chance to get away save by taking the boat with it. This it made little attempt to do, since both it and the boat were in a lagoon-like basin of water, shallow on the edges but deeper in the center. Here the fish, if not actually aground frequently, was at all times so hampered by the shallow water as to be unable effectually to exert its great strength. Some sixty shots from a 30–30 rifle were then fired into the region of the backbone, especially in the caudal section, in an endeavor to reach the spinal cord and thus paralyze the tail, the only weapon of offense and defense of this greatest of all sharks. Unlike other sharks which have both large and sharp teeth, the teeth of the whale shark are minute in comparison with its huge size for they are only about one-eighth of an inch long.



FROM A SUBMARINE MOVING PICTURE FILM
A "frame" showing the spots on the rear of the whale shark's head in the gill-slit region on the base of the pectoral fin and the anterior part of the body. Courtesy of Mr. Mack Sennett

The whale shark was then attacked with lance thrusts in the gill region, which caused great loss of blood. Weakened by this bleeding, it was finally secured by a heavy line around the "small" of the tail, and then the anglers, who had at their disposal a power houseboat and two smaller craft, began the weary task of towing the giant to the wharf at Long Key. For some time they made progress, but presently the huge fish began to surge and to thresh around with his huge pectorals, and when he did so the three boats stopped as though they had gone aground on a sand bank. Finally, about midnight, Long Key was reached, the great shark was tied up to the dock, and the weary captors sought rest and repose.

While this fish, like all the other specimens of *Rhineodon* taken in Florida waters, did not offer the resistance that might be expected from such a huge shark, still it manifested great vitality when it "came to" and made desperate efforts to break away. At three o'clock on the night of its reaching Long Key it went into a flurry which threatened to tear down the dock. Next day a number of persons were standing on the supposedly nearly dead fish, when it revived and precipitated them into the water. Several narrowly escaped being struck by waving fins. About noon on this day, Captain Knowles was swimming near the fish, when it again began to thresh about. He was struck by the waving lobes of the tail and knocked almost senseless. Had the rope around the tail not held, his life would almost surely have been sacrificed.

Finally, on the afternoon of Monday, June 11, the great fish went into a final flurry and died about 54 hours after being harpooned. He was then grounded in 7½ feet of water, but even though submerged, he was so heavy that five men tailing on a rope could not raise his head to the surface.

Early on the day after the capture of the fish, the Miami morning paper announced in streamer headlines the capture

ALONGSIDE THE DOCK AT LONG KEY, FLORIDA
Sitting on the back of the whale shark is Capt. Newton Knowles. He is thrusting a finger into a bullet hole

of the "Huge Monster," and Mr. Mowbray, who had arrived in Miami only the day before, took the first train for Long Key, where, from previous acquaintance with Thompson's mounted specimen and with Doctor Gudger's articles on the fish, he at once identified it as the whale shark, *Rhineodon typus*.

Seeing the opportunity of procuring a most valuable specimen for the American Museum, Mowbray approached Mr. Nolan on the subject, representing to him the value to science of presenting this rare fish to an institution where it would be adequately prepared and displayed to the public. Mr. Nolan with great generosity and without a moment's hesitation made the offer and Mowbray wired the Museum. The message arrived on Sunday, but since the offices of the Museum were closed and everybody away, no action could be taken until Monday. Doctor Gudger was on vacation and none other of the ichthyological staff was available, but Frederick Limekiller, of the department of preparation in the Museum, left on the first train to help Mowbray handle the specimen. However, while waiting word from the Museum, Mowbray utilized the time in making a sketch, a set of measurements, and a description of the giant fish, and in securing photographs both still and motion —a number of which are reproduced as illustrations of this article.

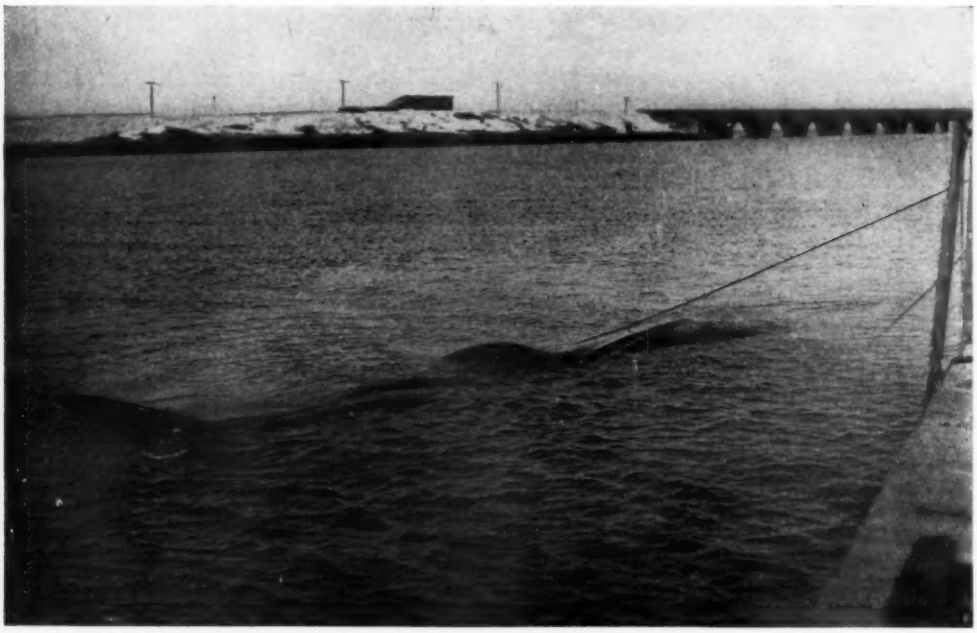
This fish measured 31 feet 5 inches in total length, was 17 feet 6 inches in circumference over the first gill slit, and in greatest girth (just back of the pectoral or breast fins) measured 23 feet. Unfortunately, since the fish was at best merely awash at the surface of the water,

it was impossible to get a broadside photograph showing how very large it was. However, it is interesting to note that the upper lobe of the tail fin which is above water is longer than a tall man. Veritably the whale shark is a "whale" in size.

The cavernous mouth was 3 feet 8 inches straight across from corner to corner. The distance across the head from eye to eye measured along the curve was 5 feet 3 inches. From the tip of the snout to the front edge of the first dorsal fin was 14 feet 6 inches, and to the front edge of the second dorsal 21 feet 5 inches, to the base of the caudal fin 25 feet 9 inches. The upper lobe of the tail was 7 feet long, the lower 5 feet 7 inches, and the vertical spread or reach was 12 feet—twice the height of a tall man. Comparison of the pictures on pages 186 and 188 with that of the mounted fish will help make clear its great size.

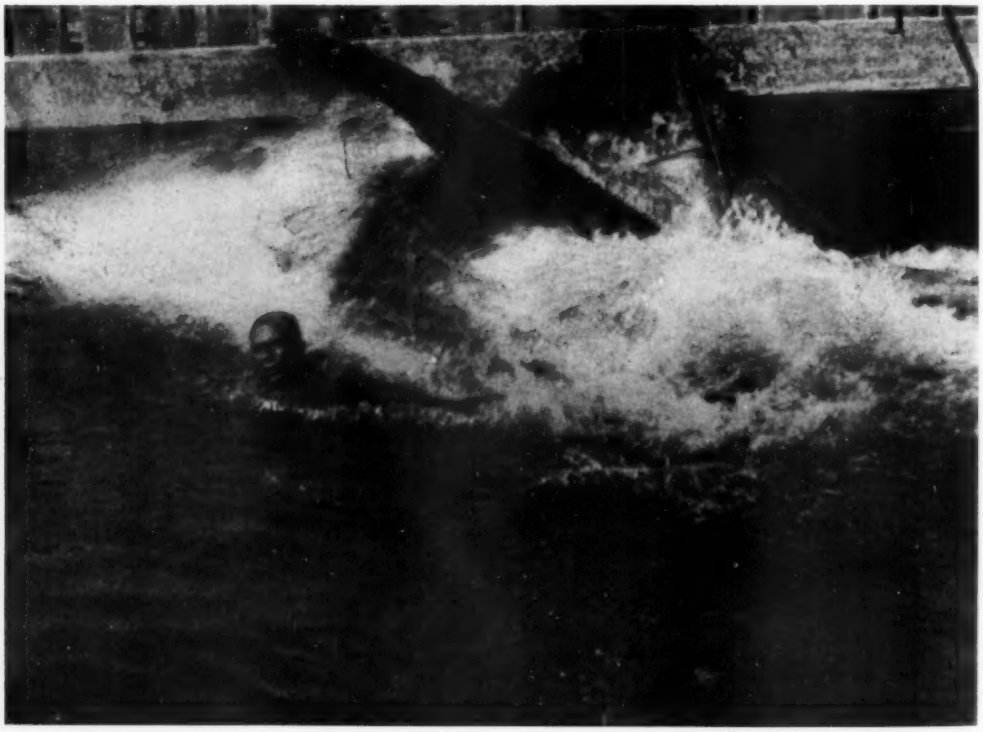
Because of its remarkable vitality, it was at first thought that the fish would live until the preparator could arrive from New York, and that it would be possible when it died to beach it at Long Key, to make plaster casts of it by sections, and to skin and dissect it on the beach. All this was proposed by wire. But the fish died, and as the rise and fall of the tide was only about a foot, and as there were not men and apparatus at hand to get it up on the beach, Mowbray wired the recommendation that it be towed to Key West and there hauled out on the marine railway for dissection and study. This was authorized by wire and he went at once to Key West to make the necessary arrangements. Here Curry and Company very generously offered the use of their tug and shipways at cost, and on Tuesday, June 12, at 3 P.M. the tug

TOWING THE WHALE SHARK TO LONG KEY
Two arches of the Overseas Section of the Florida East Coast Railway show in the background



MORE THAN THIRTY FEET OF WHALE SHARK

This picture is intended to give an idea of the great length (31 ft. 5 in.) of the whale shark which is moored to the dock at Long Key.

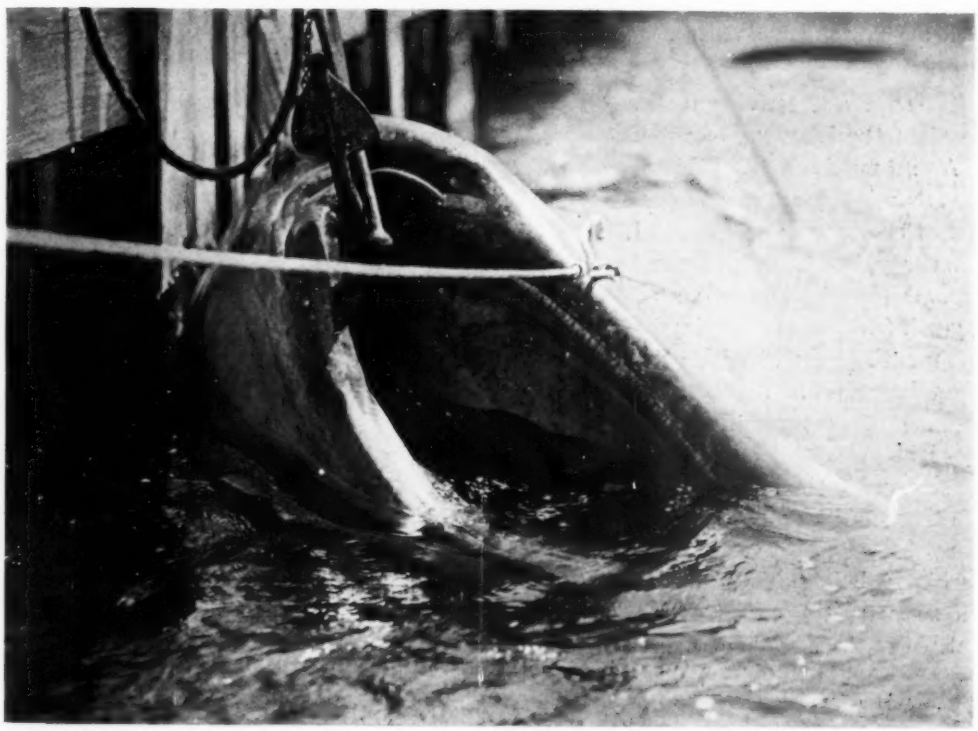


THE BIG FISH SUDDENLY "COMES TO"

The whale shark, though tied to the dock at Long Key, went into a flurry which nearly cost Captain Knowles his life. The twelve-foot tail is lashing the water into foam

THE GREAT SHARK TIED TO THE DOCK AT LONG KEY

Note the first and second dorsal fins and the upper lobe of the caudal fin. The height of this latter equals that of a tall man



THE CAVERNOUS MOUTH OF THE WHALE SHARK

With the aid of a reading-glass, one can see the tooth bands with the teeth set in rows like those of the old fashioned "cards" used long ago for "carding" wool and cotton

THE WHALE SHARK TURNED ON ITS SIDE
Note the great length of the fish and of the huge pectoral fin, which is nearly as long as the man holding it is tall

left Key West, arriving at Long Key at daylight the following morning.

An interesting natural history observation may here be noted. While the shark was tied to the dock at Long Key, Mowbray, in climbing over and swimming around it, noticed a foot-long brown sucking-fish (*Remora*) swimming in and out of the mouth of the big fish. This confirms what has elsewhere been recorded for a number of captured Rhineodons. Sucking-fishes are also found in the mouths of whales and in the mouths and gill cavities of other sharks, and also of rays and large bony fishes. Mowbray found that this sucking-fish (one of the brown forms, not the striped one) stayed with the big fish until the towing began, and possibly longer—such being its behavior toward the shark, its host.

As has often been proved by hard experience, towing a large shark behind a boat is no child's play but generally such a fish tows best when lashed head to stern of the boat. And so the whale shark was tied up when the tug (a gasoline driven boat) started from Long Key, at 8 A.M. Wednesday, June 13, on the long journey to Key West. The fish was held in a "bridle" made by looping heavy ropes around the bases of the pectoral fins, connecting these into a harness by circumferential lashings around neck, head, and snout, and then extending the heavy side lines forward to the two rear bitts of the tug.

Thus geared up, the boat started from the pier for the channel. However, the great shark was so broad in the head and pectoral region, so thin at the snout, and lay so heavily in the water forward, while at the same time it was so thin, light, and high-floating in the caudal region, that, caught in the wake of the propeller, it turned on its side and grounded its pectoral fin on the bottom. Then each time

the boat tried to go ahead she sheered sharply about and turned almost completely around. This sheering was so violent that the heavy wheel ropes broke twice.

Consequently the shark was cast off at the head and made fast by the tail. This made it somewhat easier to steer, but the shark was still an unwieldy tow, for the caudal fin flapped from side to side, and the great pectorals caught the current made by the propeller, with the result that the fish rolled over. Again, when both pectorals, caught simultaneously in the wake of the propeller, would flare out "wing and wing," they would act like the "drogue" which whalemen attach to a harpoon line to retard the flight of a whale. With this strain, the tug would be brought up "all standing" as if she had gone aground. Under these circumstances, about the best she could do was to make three or four miles per hour.

About 3 P.M. that day, while abreast Key Vaca, the coast guard launch "Cossack," in charge of Lieutenant Brown, hove in sight and came up. Key West seemed far away to the tug with her slow-going tow and, on request, Lieutenant Brown very kindly took a line aboard and helped bring the *Rhineodon* to Key West. Here it was tied up to Curry's dock about 4:30 A.M., Thursday, June 14, about twenty hours after leaving Long Key and about forty-eight hours after its death.

An unprecedented spell of hot weather had come on. At Long Key the temperature of the water was high, and with every mile to the south it grew warmer, until in the harbor at Key West a thermometer suspended in the water stood

THE WHALE SHARK WITH VENTRAL SURFACE UPPERMOST
Captain Knowles is holding on to one pectoral fin. Note the great width between the tips of the pectorals

HARNESSING THE GIANT

Note the checkerboard arrangement of spots and bars. The longitudinal divisions are produced by the three keels which run from front to back, as may be seen in the picture on page 182

at the record-breaking figure of 91.4° F. This meant that the interior of the giant shark was simply an enormous incubator for putrefactive bacteria. With every mile of southing the fish grew "gamier" and "gamier," with blood and with products of putrefaction escaping from the vent. This of course attracted the sharks (which hunt by smell) and these attacked the *Rhineodon* ferociously. At Key Vaca a great band of voracious tiger or leopard sharks (*Galeocerdo tigrinus*), some of them 12 to 14 feet long, struck in and mauled the big fish badly. As many as eight or ten could be seen at one time on the submerged back of the whale shark, struggling to tear off huge bites of the flesh or fighting among themselves like ravenous wolves. However, the skin on the back was so thick and so tightly drawn that they had to confine themselves largely to the thinner and slacker skin over the abdomen. This they tore open and then devoured most of the visceral organs. They also mauled the fins badly.

As noted above, the boats and their unwieldy tow reached Key West about 4:30 A.M., Thursday, June 14, and the great shark was tied up alongside Curry's dock. But here fresh difficulties and disappointments arose. All the ship railways but one were now occupied, and this one was out of order. So there was nothing to do but wait for this to be repaired and strengthened, and for a flooring to be put on one of the cars to hold the *Rhineodon* while it was being hauled out. Furthermore, it was necessary to wait for the coming of Limekiller, the skilled preparator, who, by stopping off at Miami for orders, missed a train and only got into Key West at 6 P.M., Thursday, June 14. This, however, ultimately made no difference, since all hands had to wait for repairs to the shipways.

These repairs were finally finished and the huge fish was hauled out about 6 P.M., Friday, June 15. However, once out of water, the whale shark flattened

TOWING *RHINEODON* TO KEY WEST

Caught in the wake of the propeller, the great shark turned on its side, ground one pectoral fin, and brought the boat up "all standing"

ATTACKED BY THE "WOLVES OF THE SEA"
The whale shark turned on its side as it was being towed behind the tug. A tiger shark, *Galeocerdo tigrinus*, is shown tearing at one of the fins

down into a shapeless mass. This always occurs to a certain extent when sharks are taken out of water, since they do not have the bony vertebral column and ribs nor the scales which in higher fishes give the body permanence of form. However, the flattening in this case was extreme, by reason of the fact that the long continued putrefaction had thoroughly broken down the muscular and other tissues. It was now found that the skin was too far gone to be saved even if it could have been loosened from the foul-smelling body. Much of the shagreen had come off in sheets and had floated away. The tooth bands, loosened by putrefaction and by sharks biting at the lips, were hanging in patches—most of them being gone. The fins had been badly torn and were partly separated from the body, the abdomen had been torn open and the internal organs almost entirely devoured by sharks. Finally, the flesh was beginning to slip from the cartilaginous skeleton.

The odor from this huge mass of decaying flesh was such that work on the fish was almost impossible, yet Mowbray and Limekiller continued their efforts by electric light to save the hard parts of the fish, until, worn out, they quit work at 2 A.M., on Saturday, June 16. Operations, however, were resumed shortly after daylight. Under normal conditions the dissection of the internal organs of a 32-foot shark having a body cavity 10 feet long would be formidable, but when the whole body is far gone in putrefaction, the task becomes truly Augean.

On this day, despite the odor, people crowded around by hundreds, and because of it complained loudly to the authorities. Finally, having saved everything not too far gone in decomposition, and all that was allowed by the limited means at hand in Key West for preservation, Mowbray had the remainder of the

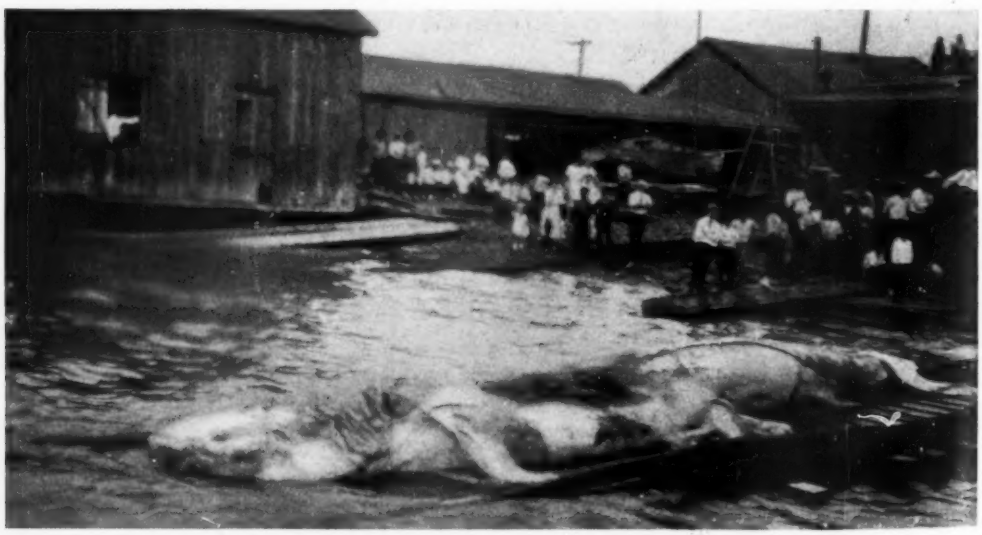
carcass towed out in the stream and allowed it to float away with the tide. This was on Saturday morning, June 16, one week after its capture and four and one-half days after the fish died.

However, a considerable number of the harder parts of the skeleton were preserved—the jaw bones, part of the gill arch apparatus, the posterior part of the skull, and several sections of vertebræ, together with fragments of the tooth band and pieces of skin. These have been worked up by Dr. E. Grace White, professor of biology in Wilson College, Chambersburg, Pennsylvania, and her paper is now in press.

An interesting aftermath to this story is that about June 20, 1924, Mowbray got from some fishermen, employed by the Ocean Leather Company in catching sharks at Big Pine Key, Florida, a horny end piece of one of the vertebral segments of a whale shark. This, they said, had been taken from the stomach of a tiger shark caught there ten days before. It is highly probable that this piece came from the whale shark taken in that vicinity the year before, since these horny structures are not digestible by the acid stomach juices of even a shark.

Such, then, is the story of the capture, the towing for eighty miles, the dissection, and the attempted preservation of the skin of the largest of the sharks. The latter part is truly a hard luck story. Had there been men and means at hand for beaching the fish at Long Key, for making plaster casts by sections, for skinning the fish, and finally for preserving the skin and hard parts, the American Museum might today have the mounted skin.

However, the Museum has the carefully made measurements and an extensive series of photographs, both stills and movies, all of which have been filed away. From these and from photographs and drawings of all known specimens mounted or in the flesh, the department of preparation of the American Museum has made a model on a scale of one to five, which is believed to be the most accurate representation in existence of this great shark. This is now on display in the Hall of Fishes at the American Museum, where, as the greatest of living sharks, it attracts much attention from visitors.



HAULED OUT ON THE MARINE RAILWAY AT KEY WEST
The flattened condition of the body of the whale shark is due to the absence of ribs and other bony parts, and to the softening of the muscular tissues by putrefactive bacteria

KING ALBERT INAUGURATES THE PARC NATIONAL ALBERT

Five Hundred Thousand Acres Set Apart as a Sanctuary for the Preservation of African Wild Life, to Which Scientists from All Over the World May Come for Biological Study

By MARY L. JOBE AKELEY

During King Albert's journey through the National Parks of the United States in 1919, His Majesty recognized at once that similar Belgian parks should be located, not in the densely populated areas of the mother country but in the vast wilderness of the Belgian Congo. His act in creating the Parc National Albert points to that long-hoped-for internationalism in conservation and in science and to a widening interest in protection throughout all Africa.—The Editors.

ONCE in a long while, a vision is quickly translated into reality. More frequently the patience and loving labor of years is necessary to make the dream come true. When the final organization of the Parc National Albert occurred, eight years had passed—almost to the day—since Carl Akeley had conceived of a great wild-life sanctuary in the Belgian Congo. Africa's first national park was created by Royal Decree in 1925, and now, in 1929, increased tenfold in area, it was provided with a working machine.

On the morning of October 19 last, the golden sunlight was flooding the *Palais des Academies* where an assembly of one hundred scientists, diplomats, government ministers, and lawmakers stood awaiting the entrance of His Majesty, Albert, King of the Belgians, who was to deliver the address formally installing the *Commission du Parc National Albert*. This committee of eighteen scientists had been nominated in August. It was composed not only of Belgians but of representatives of England, France, Sweden, the Netherlands, and the United States. I deeply valued the invitation of the President of the Commission, Prince Eugene de Ligne, to be present at this ceremony. During the three years since my husband had made the supreme sacrifice in the spot he loved best in all Africa —the Gorilla Sanctuary of the Kivu— my concern for the outcome of his vision had been no less than his. That the King in his graciousness should tell me personally of his appreciation of my husband's effort, and that he should pay tribute to his achievement in the royal address was an honor that touched me profoundly.

King Albert outlined briefly the objects which he had in view in creating this reserve for various branches of scientific research. After referring to the great national parks he had seen in the United States and the useful work accomplished in that line in other countries, His Majesty pointed out the constantly growing tendency to preserve fields for scientific study, and said, in part:

> The Parc National Albert is really unique in the world on account of the infinite variety of its flora and fauna arising from its geographical situation and on account of its geological formation and the great diversity of its altitudes, which vary from three thousand to fifteen thousand feet in different parts of the area. I am convinced that, in time, it will prove of inestimable value to scientists and to all who love nature and are interested in it.
>
> Within the limits of the Parc which, without considering its surrounding protective zones, comprise five hundred thousand acres, are found species of the vegetable kingdom indigenous to

Photograph by Times Wide World

HIS MAJESTY, ALBERT, KING OF THE BELGIANS

Lover of nature and friend of the wilds, he has created a corporate body in the Kivu and in the mandated territory of Ruanda-Urundi for preservation of fauna and flora and for strictly scientific purposes

the marshy tropical regions; there are also arid tropical forests and humid tropical forests and forests of both temperate and cold subtropical regions. Upon the high summits of the volcanoes one reaches the treeless alpine zone.

From the zoological point of view, the northern sector of the Parc includes species of East African fauna which differ greatly from those found in other parts of the Belgian Congo. On the other hand, the chain of volcanoes is inhabited by species peculiar to high mountains and also by a mixture of animals which have migrated from the East and from the West.

From the point of view of geology and mineralogy, the aspect of the region is not less varied. Furthermore, from the point of view of ethnography the district is remarkable on account of the simultaneous presence of Bantu and Hamitic elements as well as Pygmies. These latter represent the most primitive race in Africa.

It will be seen, from what I have just said, that no other region of the African continent offers such wide opportunity for scientific study and for the installation of scientific research stations which would be easily accessible and in a climate almost ideal for the white race.

I cannot omit recalling to mind the great part in the conception of the Parc National that is due to Carl Akeley, the distinguished American naturalist and conservationist, whose loss we deplore. He gave his life there while engaged in the task to which he had devoted himself, but his work has been carried on and completed through the brave efforts of Mrs. Akeley and the zeal of our compatriot, Doctor Derscheid, who, in carrying out the plan of the reserve, exhibited an activity, a devotion, and an ability which I cannot sufficiently praise.

I thank the members of the Commission which we have installed today for the valued collaboration which they have been kind enough to give to this work, and I wish especially to express appreciation to the foreign members who have graciously responded to our appeal. Their participation in the work of the Commission gives it that *international character* which in these days should mark every scientific enterprise. A large field of study is, henceforth, open in our Colony to geologists, biologists, ethnographers, and scientists of *all nations*.

In our day there is much zeal, and rightly so, for the preservation of the monuments left us by the Past. Here, in the Belgian Congo, you have also a monument to conserve—a monument raised by Nature during the course of thousands of years, and which has been handed down to us in the form in which it has been fashioned by the hand of Time from the earliest Ages of the world even to our own day.

There stands before you a great work to be achieved. In opening up and maintaining this exceptionally interesting region for the benefit of scientific research, Belgium will add a new contribution to the progress and application of Science.

Thus Albert, King of the Belgians, conservationist, lover of all the wild beauties of nature, compassionate and far-seeing, by his wise and generous action has created for the scientists of the world a remarkable opportunity for research—an opportunity for investigation among the extinct volcanoes where great mammals roam at will through age-old forests even to the rim of lifeless craters veiled in shifting clouds or scintillating with freshly fallen snow; where flocks of strangely brilliant birds dart to and fro—whose songs break the silence of the wilderness; where strange, naked little men—the pygmies—dwell in nest-like homes of sticks and grass; where subterranean fires have broken bounds, torch-lighting the heavens by day and night; where many hippo laze in sloth in tepid tropic rivers; where herds of antelope find pasture in a land unfit for wheel or furrow; where one of the few rare places of earth is free from man's economic need with its consequent urge to destroy or convert the gifts of nature.

That scientists will appreciate this international privilege—this rare gift to them—we are confident, since the age-old secrets of this wonderland are only waiting to be revealed, and man's investigative spirit is today increasingly and startlingly alive.

KARAMOJO

ONE OF AFRICA'S ODD CORNERS

An Area Inhabited by a Primitive Tribe as yet Unaffected by White Man's Customs and Ideas

By GEORGE F. SHEARWOOD
Captain, Royal Army Reserve of Officers

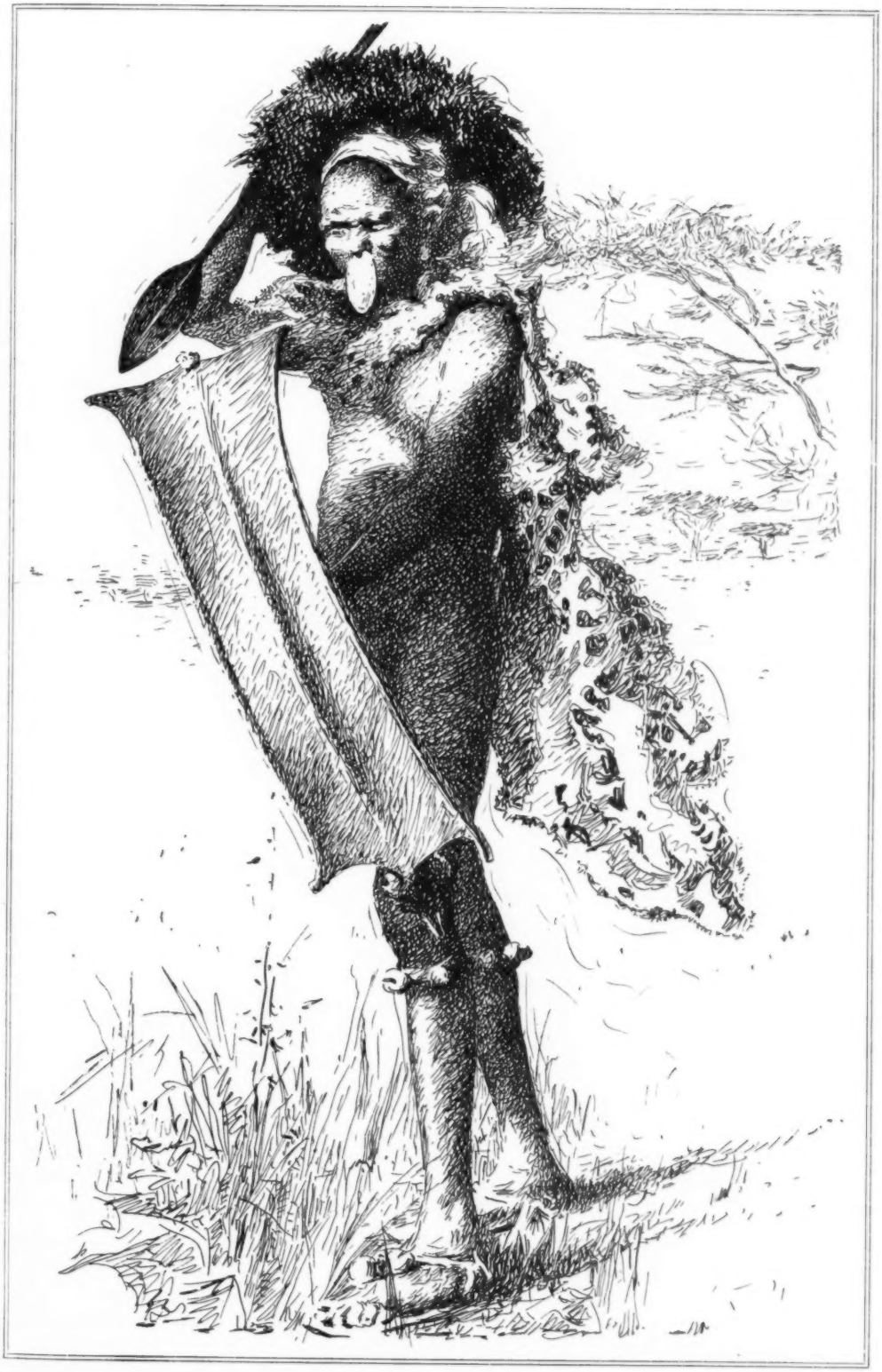
With Five Drawings by A. A. Jansson

THOUGH Africa, thanks to the work of Livingstone and Stanley and their successors, has to a large degree ceased to be the "Dark Continent," there remain many sections about which little or nothing is known. These are odd corners, perhaps, well off the beaten and over-exploited tracks, but all possess peculiarities of their own, and there is a queer satisfaction to be obtained from delving into them which is sufficient reward for the curious. One of these "bits left over" is the land of the Karamojo, a border strip of the British protectorate of Uganda, and a country which can very justly be tagged with that somewhat grandiloquent British label, "an outpost of Empire."

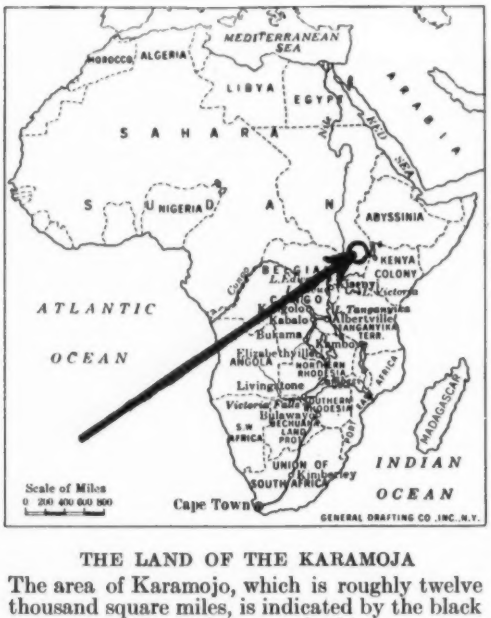
To convey an idea of the location of this practically unknown district it is easiest to take the Victoria Nyanza, the largest of the African backbone of great lakes, as the jumping-off place. Leaving Jinja, the port at the northern end of the lake where the waters of Victoria tumble over the Ripon Falls to form the source of the River Nile, the journey commences by train to Namasagale, about sixty miles distant and the first point at which the Nile becomes navigable. From there the familiar flat-bottomed tropical river steamer chugs slowly along the river, with its interminable vista of papyrus swamp, and turns eastward into Lake Kioga which is in effect nothing more than a swampy bulge in the right side of the river. Disembarking at the far eastern end of Kioga, a road, and a good one for this part of Africa, leads about sixteen miles still farther to the east to Soroti, the government headquarters of the Buteso district. Soroti boasts a District Commissioner's office, small hospital and police post and a few Indian "dukas" (stores). Its white population probably at no time exceeds six or seven people, but, at that, it is the last place at which it is possible to replenish food supplies and in which the amenities of more or less civilized life can be enjoyed before taking off for the last stage of the journey, a strenuous safari of seven or eight days over country for the most part devoid of roads of any sort.

Practically due east lies Karamojo, and after the safari leaves the Buteso district it treks for two full hard days across open plain entirely uninhabited by human beings. North of the safari's line of march lies Lake Kirkpatrick, named for an early adventuring pioneer. This section of the country is a sort of No Man's Land dividing the Buteso from the Karamojo, and while harboring some game, is, on the whole, pretty desolate. The welcome end of the safari is Moroto, a post established at the base of Mount Moroto and the only passably livable spot in the whole of Karamojo. Moroto, incidentally, is on the road over the Uganda boundary into the Turkana district of Kenya Colony and on eventually to Lake Rudolf.

Karamojo is situated at the extreme



A CHIEF OF THE KARAMOJA
He is wearing a headdress of ostrich feathers and, just below the knees, strings of iron cow bells. The shield he carries is made of hide



THE LAND OF THE KARAMOJA
The area of Karamojo, which is roughly twelve thousand square miles, is indicated by the black circle on this map of Africa

northeast corner of Uganda, its boundaries being, on the north, the southern border of the Soudan, on the east the great escarpment which forms the wall of the Rift Valley and at this place divides Kenya from Uganda, on the south the Turkwel River with the southwestern corner marked by the majestic bulk of Mount Elgon, the fourteen-thousand-foot extinct volcanic peak seen in the distance by everyone who has traveled the Uganda Railway to its terminal at Kisumu. The Turkwel also marks a part of the Kenya-Uganda boundary line, though curiously the small village of Kacheliba on the Karamojo and Uganda side of the river was in the writer's time, and probably still is, the headquarters of the officer administering the Suk country of Kenya Colony. To the west of Karamojo lies the Buteso district already mentioned, and north of it the Acholi country of which Kitgum is the headquarters.

The area of Karamojo is roughly twelve thousand square miles, about a three-hundred-mile long strip of country perched on the edge of a three-thousand-foot escarpment, the southern part of it being mainly plain and thorn bush, with occasional high points like Moroto and Mount Debastien and plenty of evidence of past volcanic activity in the shape of huge bowlders and stones left strewn about where such things were obviously never meant to be. Rather more than a third of the district at its northern end remains thick wild jungle, almost impenetrable and practically impossible to supervise. The Karamoja proper do not inhabit more than the fringe of this part of the country, but out of it come occasional raiding parties of the wild Donyiro and Marille tribes from the Soudan, and sometimes the dreaded Havash—as the Abyssinians are called—from southern Abyssinia, which is little more that the proverbial stone's-throw away to the northeast.

Karamojo is on the road to nowhere in particular and probably can never be of any real value, but it forms a buffer between the wild and the lawless tribes of the north and the more peaceful and settled countries of the south and west. Its people need protection from outside aggression, as well as whatever help the white man can give to a tribe whose principal need in life is rain in the dry season.

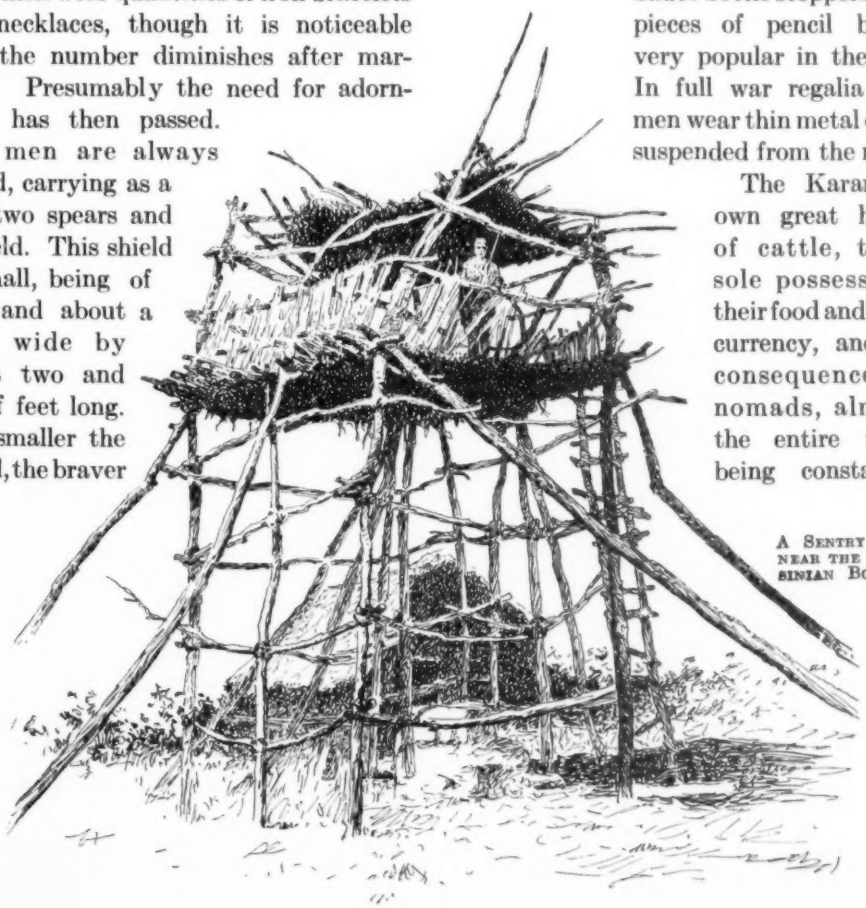
The Karamoja are Hamitic and in general appearance and physique closely resemble their neighbors, the Turkana, and the famed Masai, though they do not possess in anything like the same degree the extreme warlike characteristics of the latter. They are tall and slim, with long heads and thin nostrils and lips, and are almost dead-black in color. Active and brave enough when occasion demands, they are not a particularly martial tribe, probably because their country, being high and comparatively arid, has not been, so far as is known, the scene of serious invasion. The raids from the north have been generally inspired by the desire for

ivory, and the capture of cattle and girls from the Karamoja has been rather in the nature of a side-show for the raiders, though serious enough for the victims.

The tribe is primitive in the extreme. The only article of dress—if such it can be called—worn by the men is a skin hung from the shoulders and reaching down the back to about the middle, while the women wear a skin of about the same size hung from the waist,—much like an apron worn behind instead of in front of the body. Sometimes the women wear two or three skins in this fashion, but with both sexes the skins so worn are less articles of clothing than protection from the cold of the night and from rain. It is merely a convenient method of carrying the blanket!

Women wear quantities of iron bracelets and necklaces, though it is noticeable that the number diminishes after marriage. Presumably the need for adornment has then passed. The men are always armed, carrying as a rule two spears and a shield. This shield is small, being of hide and about a foot wide by about two and a half feet long. The smaller the shield, the braver the race. For instance, the Kavirondo, who live beyond Elgon, in war array carry enormous shields, and are painted and feathered into the most grotesque and fearsome creatures, but in battle cannot compare in courage with the Masai or Karamoja. The Karamoja, in common with most Africans, don war-paint, smearing their bodies with whitish and reddish clay, and wear a headdress of ostrich feathers, and, just below the knees, strings of iron cow bells. Auxiliary weapons consist of a bracelet with a circular knife edge, and finger-rings with hooks an inch or more long used for the pleasant purpose of gouging out an enemy's eyes or tearing any other handy part of the anatomy. The ears and lower lips of both sexes are pierced to hold ornaments,—Worcester Sauce bottle stoppers and pieces of pencil being very popular in the lip. In full war regalia the men wear thin metal discs suspended from the nose.

The Karamoja own great herds of cattle, their sole possession, their food and only currency, and in consequence are nomads, almost the entire tribe being constantly



A Sentry Post near the Abyssinian Border

on the move in search of grazing land and water. In the rainy season there are many roaring rivers, but in the dry season it is common to see holes dug in the river beds to a depth of twelve feet and more before water is reached. This nomadic form of life is mainly responsible for the clan form of government practiced, and there is no paramount chief of the tribe.

Each clan or section has its headman who may hold his post by right of inheritance, election, or sometimes strength of arm. The headman holds all authority in his section, though in the normal round of peaceful life he seldom acts without consulting with the older men.

Life is one monotonous round. The only task of the men is to prevent attack by either animal or human. The women do all the communal work of cooking, dressing of skins, collecting of fuel, hunting for the rather rare edible berries, while the boys tend the cattle and the girls the sheep and goats. At night, a boma, or circle, of thorn-bush is built, into which the clan and its cattle retire. Fires are lit, and each family resting place consists of nothing more than a branch of a tree placed to windward and covered loosely with some spare skins which are supposed to act as a shield from wind and storms. Father and mother and infants sleep together, while the older, but still unmarried, children spend the night away from their elders. Young men and girls are supposed to sleep apart but the rule is not very strictly observed.

THE WOMEN OF KARAMOJO WEAR QUANTITIES OF IRON BRACELETS AND NECKLACES

The Karamoja, being nomads, eat virtually nothing but meat and drink only milk, or milk mixed with blood, a peculiarly filthy looking concoction. Sick cattle are eaten as a matter of course, apparently without any ill effects. Game is preferred to

cattle, merely because the cattle—which is the measure of wealth of the community—is preserved. The few clans that have established themselves in one place because permanent water and grazing are available, grow some matama, a type of grain from which porridge is made.

When in Full War Regalia, the Men Wear Thin Metal Discs Suspended From The Nose

Such an extremely primitive mode of living has not made for intelligence on the part of the people, who are mentally very simple though not necessarily stupid. In a life which is measured entirely by a bare sufficiency of food and drink and freedom from attack, there is little to sharpen the wits, and, as with most savages, no thought is given to tomorrow, no curiosity exists as to what may lie beyond the confines of the tribal grazing grounds.

In dealing with such a back-of-beyond tribe, the most important attribute of the white man is patience. With patience might be bracketed honesty of purpose, for it is the writer's opinion that the savage senses at once whether or not he is going to get a square deal. When satisfied on this point, he will at least tolerate the intruder, who then may accomplish some useful work, otherwise the white man will find his lot a hard and dangerous one.

As Uganda is a protectorate, the British administration is concerned primarily with the protection and betterment of the natives, and no attempt is made to impose the white man's customs and ideas willy-nilly on people wholly incapable of understanding them. The law of the protectorate is the Indian Penal Code, but this is only operative when an offence is committed against an established order of the white administration. To what extent the law is applied may differ in various sections of the country, and depend on local conditions and the state of development.

Karamojo was, in the writer's time, a closed or military district, with the administration in the hands of officers of the King's African Rifles, a native force commanded by British army officers lent for the purpose. The district's classification made permission necessary before any

outsider could visit, settle, or trade in it. No attempt was made to interfere with the age-old customs and social code, and the exclusion of all unauthorized persons made the work of administrative supervision as straightforward as possible.

The Karamoja tribal law, probably as old as the beginning of time, is fascinatingly simple. There are only three forms of crime recognized, or in fact possible among such very primitive folk. These three are murder, theft, and seduction. Trial is by a meeting of the "Atuk," or court, which consists of as many clan or section headmen as can be brought together conveniently, and is an extremely interesting exposition of fair play and Solomon-like justice. The law relating to homicide is only applicable when the crime is committed within the various sections of the tribe itself, as murder of a member of another tribe is rather a mark of herosim and an occasion for celebration.

The writer had the good fortune to attend an "Atuk" immediately after arriving in the district and while still a stranger to the tribe. The case was the murder of a girl by a young man and the procedure was simplicity itself. In a grass hut were seated the judges, twenty or more of them; the prisoner, led in at the end of a hide rope fastened round his neck, was placed before the court. The father of the murdered girl acted as prosecutor and produced himself and others to prove the case against the defendant, who was allowed to testify in his own defense. The court conferred for a perfunctory minute or two, for the case was to all appearances a clear one, and found the prisoner guilty, whereupon the bereaved father led him out to his doom. There was a slight scuffle, a gurgle, and the sound of a falling body just a few feet away. Justice had been done! The tribal law takes an eye for an eye and a tooth for a tooth, and even goes one better, for it gives the nearest male relative of the victim the right to carry out the sentence.

Theft, which can be only of cattle, as there is nothing else to steal, is generally punished by the imposition of a fine on the whole of the thief's section, besides the return of the stolen cattle. The fine can amount to the same number of cattle stolen or a greater number, and can even be made to extend over a period of time. Naturally, a thief is not exactly popular, so that theft is a comparatively rare crime, for generally the thief is forced to become an outlaw, and, as such, he is not welcome among other sections, and he may even see his ill-gotten gains die from lack of the water and grazing he cannot share with others. A very considerable part of the inter-tribal trouble and fighting is caused directly by outlaws, who, resenting expulsion from their own people, go over to neighboring tribes to act as leaders in raids.

Seduction of a man's wife can be as serious a crime as murder and punishable in the same manner, or, if the outraged husband chooses to take the law into his own hands and kill the seducer, it might be regarded as justifiable homicide. Also a fine of cattle can be imposed on the offender's section, though this is not often done. On the other hand, the offence may be forgiven entirely and no punishment imposed other than that the offender keep the woman. It all depends on the husband and how highly he prizes his wife. In the case of an unmarried girl, the situation is much the same, but invariably is regarded more seriously, and at least a fine is almost certain to be imposed, for, though no punishment is inflicted upon the girl, her value in the marriage market is considerably reduced, and this means an economic loss to her family.

Marriage is by purchase, the price for a bride being from five cows downward, according to the age and comeliness of the

girl. There are some traces of courtship, probably because the man wants to ascertain the desirability of his prospective wife, her temper, and, most important of all, her ability to work. The arrangements are made by the bridegroom and the family of the bride, and after the price is agreed upon, the couple do not see each other for a period lasting anywhere from a couple of weeks to two months, when the marriage is celebrated by the man coming with his friends to claim his bride. A sham battle begins the celebration, a survival of the days when the bride actually was won by force, and much feasting is indulged in, often lasting for days after the pair have begun life together. The number of wives a man may have is ruled entirely by his purchasing ability. On a man's death, the care of his family devolves on his brother or next surviving relative. This involves no hardship, as the more women a man has, the greater degree of comfort he lives in.

As with most savage tribes, the Karamoja youth remains a boy and of no account until he has proved his warlike proclivities satisfactorily and has won the status of a warrior. To do so, he has to fight and kill an enemy, and herein

A Soldier in the Kings African Rifles, a Native Force Commanded by British Army Officers

lies one of the chief reasons for the inter-tribal feuds which are the worst thorn in the side of the white authorities. This killing of an enemy is most often plain murder of some unsuspecting member of another tribe, a spear in the back while he sits guarding cattle or sleeps at night. The method matters not, so long as positive proof of the kill is supplied.

The lad is recognized as a warrior after undergoing the ceremony of blooding. This horribly painful performance consists of branding the body of the young warrior with a succession of inch-long cuts across the body from the center of the chest outward, and from the shoulder to the waist. The number of these marks is only limited by the man's ability to endure the pain caused by the cutting and burning performed to record his bravery. The one discrimination observed is that, if the victim of the new warrior was a man, the right side is tattooed, while for a female kill the left side is used. Among the older men are many marked completely across the body, signifying that they have killed both a man and a woman. Though it has not been completely eliminated, this practice is fast dying out, owng to the action of the British authorities, for apart from all humanitarian aspects, it is the cause of much worrying and senseless inter-tribal war.

Karamojo has its quota of wild animals, but it is not the so-called "sportman's paradise" that parts of Kenya and Tanganyika are. However, a wide variety of game roams the plains, while in the north the elephant thrives in the dense bush.

An undistinguished country in many respects, yet Karamojo has a fascination and interest which so many regions in Africa have lost since the advent of the white man and the gradual conversion of the native to his methods.

Stark naked and supremely indifferent to progress, as they are, the inhabitants of this African odd corner live their lives as their ancestors did back in the distant past, and one leaves them with a feeling that one's association with them has been well worth while.

AN ADULT SOCIABLE WEAVER BIRD NEAR ITS NEST

THE SOCIABLE WEAVER BIRD OF SOUTH AFRICA

How the Social Habits of this Remarkable Bird Architect Prompt it to Construct "Apartment-house" Nests, in which it Lives in Colonies

By HERBERT FRIEDMANN
Curator, Division of Birds, U. S. National Museum

The American Museum greatly desired to obtain one of those marvels of the bird world, a nest of the sociable weaver bird, both for the information and pleasure such an exhibit would give to the public as well as for its scientific value. Therefore, when in 1924 Doctor Friedmann was planning to go to South Africa on quite another mission, it was decided that the opportunity to procure materials for an exhibition group of the social weaver might not repeat itself for some time, and Doctor Friedmann gladly undertook to try to collect the desired material. The remarkable structure will be put on exhibition at the American Museum. Doctor Friedmann's observations, on which this article is based, were made chiefly around Maquassi, Transvaal, January 15–23, 1925, and are published in this issue of Natural History *by permission of the Secretary of the Smithsonian Institution.*—The Editors.

AMONG the many wonders of Africa's teeming bird population, surely one of the most prominent is the sociable weaver bird. As a bird among other birds, it is very ordinary looking. Its modest plumage and unimposing appearance, however, form but the outer aspect of what in all fairness must be granted to be the mightiest of all avian nest-builders, the greatest bird architect in the world. When we consider the delicately constructed and ingeniously decorated or concealed nests of some of the orioles, humming birds, and tailor birds, this statement has all the more force. It is freely admitted that some other birds may build nests of finer structure or of more intricate workmanship, but if we think of such aspects of building as bulk, strength, durability, and the consequent safety afforded the inhabitants, then the achievements of the sociable weaver stand out in their true value.

The wonderful colonial "apartment house" nests of this bird have excited

A NEST COLLECTED FOR THE AMERICAN MUSEUM

Doctor Friedmann covered an area approximately one hundred miles long and ten miles wide looking for a nest which was suitable for exhibition

much comment on the part of the relatively few naturalists who have had the privilege of seeing them and studying the builders in their remote African home. The massive bulk of the nest structures, however, made it impossible to collect and transport specimens to museums in other lands before a railroad had been pushed through the rather dreary part of Africa that produced these remarkable birds. But now that has all been accomplished, and a person may travel in a comfortable train from Cape Town, and, in a day's journey, get to where he can see these famous nests that were hitherto gazed upon only by indifferent and unappreciative Hottentots or Bushmen, or scrutinized by the inquiring eyes of a casual explorer.

A rather tawny, sparrow-like bird with a black patch on the chin and upper throat, and with the back presenting a somewhat scale-like appearance due to the buffy edges of the dark brownish feathers, the sociable weaver strikes the observer in its native haunts as being exactly what it is—a close relative of the now ubiquitous house sparrow of our city streets. In voice, gregariousness, feeding habits, pugnacity, and general mannerisms, it recalls its more cosmopolitan relative. This is all the more noteworthy in view of the recent discovery by Sushkin that the latter is a weaver bird and not a member of the true finch family. In this particular instance field observations and laboratory studies supplement each other unusually well and point independently to the same conclusion. In view of the fact that both are very generalized in form and structure, neither eminently specialized in any one direction, it is quite puzzling that one group (*Passer*—the genus to which the house sparrow belongs) should have spread all over Africa, Europe, and Asia, and, more recently, through artificial means, the rest of the world as well, while the other (*Philetairus*—the social weaver) should have remained in a very restricted area.

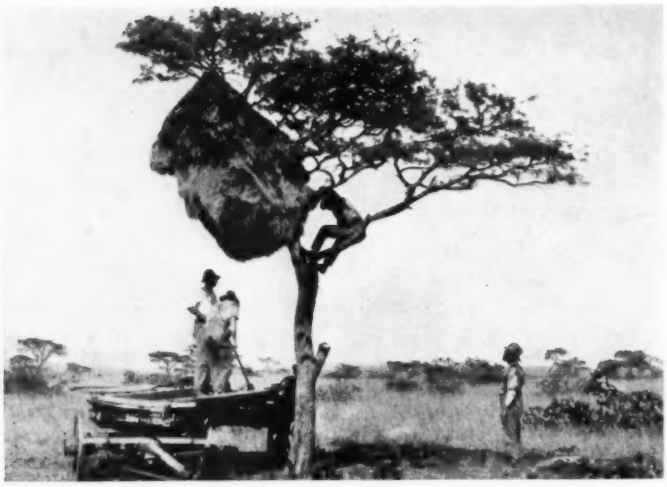
The social weaver is an inhabitant of the rather arid acacia-dotted grass veldt

of southwestern Africa—the extreme western Transvaal, adjacent portions of the Orange River Colony and the Cape Province (Griqualand West), and particularly of Damaraland and Namaqualand, north to Ovampoland and the Kalahari Desert. Like most denizens of dry regions, it is subdued and sandy in coloration, but otherwise it is not obviously adapted to a semi-desert environment.

As the common name of the bird implies, *Philetairus* is very social in its habits; in fact it is probably as social as any bird could possibly be. It is always found in flocks, feeds in flocks, and breeds in large, "many-apartmented" compound nests. The smallest flocks that I saw contained about twenty birds; the largest one at least a hundred and fifty. The flocks seem to stay pretty much in the same general vicinity all the year round, and the birds use their huge, massive nests as roosting places during the nonbreeding season. With this extreme sociability and sedentary habit of life the territorial relations of the species have been modified in a way that is quite remarkable, perhaps unique, among birds. Instead of each pair of birds having its own breeding territory, each flock seems to have a definite territory, and as the individual flocks are usually far enough apart not to compete with one another, the boundaries of these territories are seldom crossed by individuals of other flocks and other territories. However, in a few cases in my own experience, two flocks were fairly close together (i.e., two nests were on trees not very far apart), and the birds mingled more or less while feeding, but in these cases far more fighting and quarreling was observed than in all the others

THE UNDERSIDE OF A NEST

It is possible to distinguish numerous entrances in this close-up view. These lead to the individual nests which make up one large, compound, "apartment house" nest



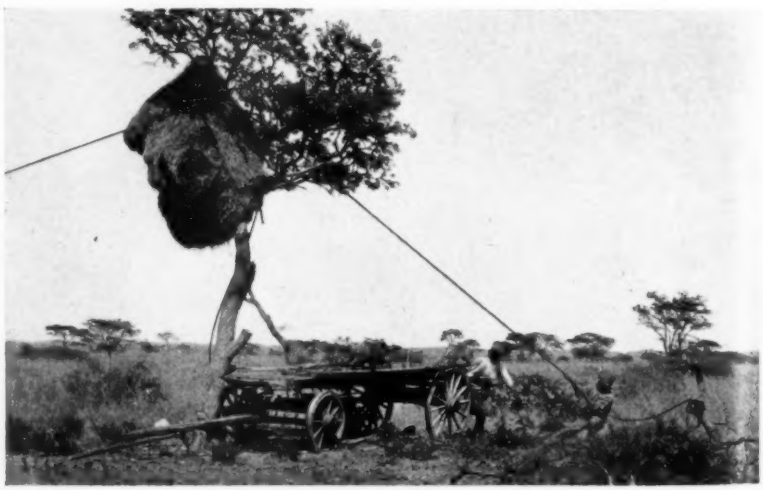
COLLECTING A NEST

The first step in preparing this nest for its journey to the American Museum was to trim all extra branches from the tree on which it grew

together. In an area approximately one hundred miles long and ten miles wide, or a thousand square miles in all, that I covered while looking for a nest suitable for transport to New York for exhibition purposes, I found only twenty-six nests of the social weaver, so it can be seen that the flocks ordinarily do not live in very close juxtaposition to each other. (The nests are so large and conspicuous at great distances, and the country so open and easy to examine, and the trees so relatively few in number, that I am quite certain I found practically every nest in this area.)

The nests observed varied in size as did the flocks. The smallest nest found measured some three feet in diameter at the base, was about three feet high, and had perhaps ten entrances on the under surface, indicating that it contained that number of individual nests. The largest one found was incomplete, i.e., a piece of it had broken off, breaking its supporting branches by its weight, but the remaining part was a large, flat, horizontal mass of straw, more or less repaired at its broken edge, and measuring about twenty-five by fifteen feet at the base and about five feet in height. The part that had broken off must have been about five feet in diameter each way. This nest contained about ninety-five nests within it.

In a locality where these birds occur it is impossible to remain long unaware of their presence. Trees are not so numerous but that each one becomes an object of considerable importance in the landscape. Needless to say, a tree on which



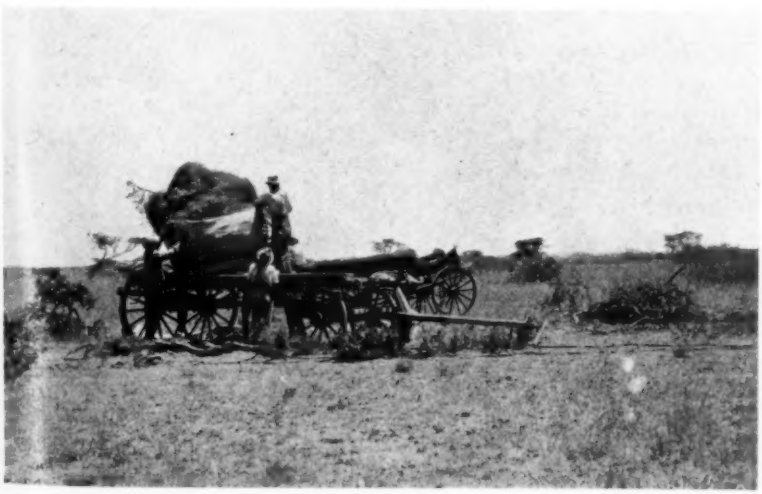
LOWERING THE NEST TREE

The second operation was to chop the tree nearly through at its base, and then very carefully lower it until the nest reached the waiting truck

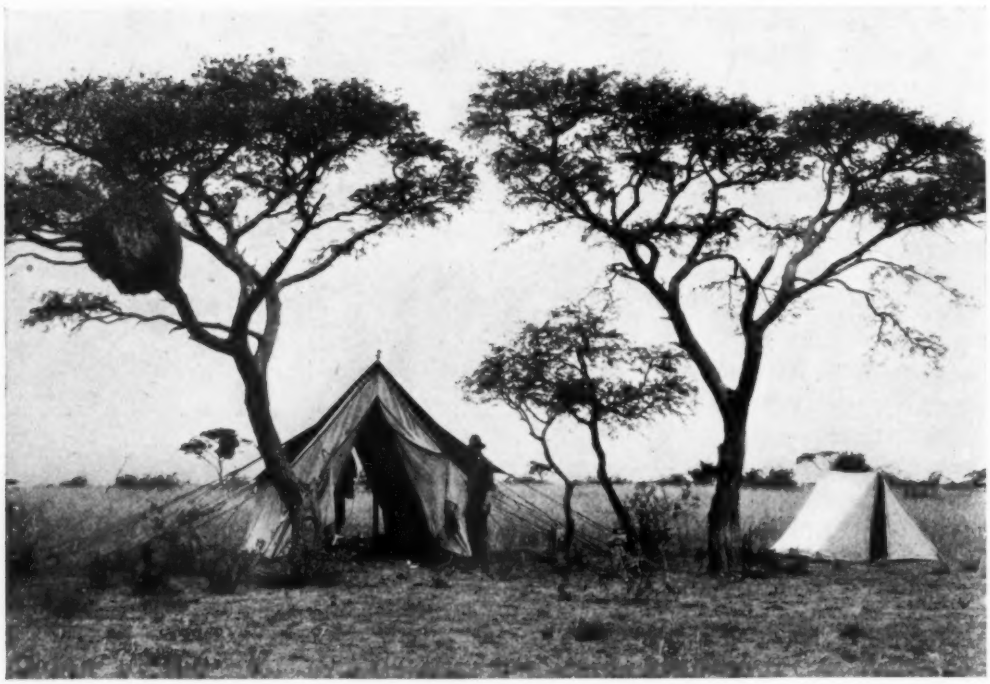
there is a social weavers' nest is a very conspicuous object, visible for a great distance and widely proclaiming the presence of the builders. But the birds themselves soon intrude upon one's consciousness with their noisy, harsh, chattering notes, as they fly by in flocks, or feed in scattered bunches upon the seeds of the small, stunted shrubs and plants that wrest an existence from the inhospitable soil. While feeding, they keep up an incessant chatter much like a flock of house sparrows, and like them, frequently quarrel over bits of food. In flight they all act in unison with a precision quite remarkable for birds of their type, the whole flock turning, rising, falling, wheeling, and stopping more or less together.

READY TO START FOR THE RAILROAD STATION
The nest and accessories were then drawn across the arid grass veldt to the railroad where the packing and crating were finished

Although the birds live in compound "apartment-house" nests, feed and fly in flocks, and are at all times exceedingly gregarious, they mate in regular monogamous fashion as far as my field observations indicate. If they were promiscuous they would be forever in one another's way getting in and out of the entrance holes of the individual nests in the large communal structures. As a matter of fact the harmony of life within each colony, the lack of what may be likened to "traffic congestion," that is, the coming and going of birds in the task of providing food for the young, the fact that out of numbers of individual nests examined by various observers none were found with unusual numbers of eggs or young, all argue for the actuality of monogamy.



WRAPPING THE NEST
A covering of burlap, followed by burlap soaked in plaster, then chicken wire and more plaster, were used as a protection



CAMP NEAR MAQUASSI, TRANSVAAL

A new, and consequently small, social weavers' nest is hanging on the tree at the left

There have been several attempts to explain the structure of the large, composite nests of this species, some writers claiming that each pair of birds builds an individual nest, all of them close together, and then the flock builds the common roof over all the nests, while other writers have recorded that the flock builds a large structure and then each pair builds its individual nest into this structure. I have never seen the actual beginning of a nest and the smallest nests I found were, as mentioned above, complete structures with numbers of nests within them.

We may therefore quote the account of the building process given by Sir Andrew Smith, from Shelley's *Birds of Africa* (Vol. IV, 1905, p. 131).

> The most striking peculiarity observed of the species is the extraordinary manner in which a number of individuals associate, and build their nests under a common roof. When a nesting place has been selected, and the operation of building the nests is to be commenced *ab initio*, the community immediately proceed conjointly to construct the general covering which interests them all; that being accomplished, each pair begins to form their own nest, which like the roof, they construct of coarse grass; these are placed side by side against the under surface of the general covering, and by the time they are all completed, the lower surface of the mass exhibits an appearance of an even horizontal surface, freely perforated by small, circular openings.
>
> They never breed in the same nests a second time, though they continue for many years attached to the same roof. With the return of the breeding season, fresh nests are formed upon the lower surface of those of the previous year, which then forms an addition to the general covering. In this manner they proceed, year after year adding to the mass, till at length the weight often becomes such as to cause the destruction of its support, upon which a new building-place is selected. They appear to prefer constructing the nests upon large and lofty trees, but where such do not occur, they will even condescend to form them upon the leaves of the arborescent aloe (*Aloe arborescens*), as occa-

sionally happens towards the Orange River. The commencement of the roof is firmly interwoven with the branches of the trees to which it is intended to be suspended; and often a great part of a principal branch is actually included within its substance.

The only point that I can add to Smith's description is that not only do the birds build their individual nests, but during the non-breeding season, all the members of the flock do a certain amount of roof building and repairing of the whole structure. All the birds work together equally, the males as well as the females, and even during the breeding season, when they have eggs or young in the nest, the birds may be seen carrying straw to the roof or other parts of the common structure, not necessarily close to their own respective individual nests. The huge, massive affairs are composed chiefly of small twigs and of dried grasses of a rather coarse, tough sort that grows commonly in southwestern Africa, and the seeds of which enter very largely into the diet of the weavers. The material is not really woven or even plaited on the surface of the nest, but is rather roughly put together in about the same way that hay is put into a well-made hay rack, but with a fairly definite thatching arrangement, causing the rain to run off and not to soak through. The under side of the nest presents the rough, hard ends of the coarse straws, and forms a very uneven surface.

The breeding season of this bird in western Transvaal is at its height in December and is practically over by the middle of January. Consequently I was too late to learn much of the nest

A NEST BROKEN BY ITS OWN WEIGHT

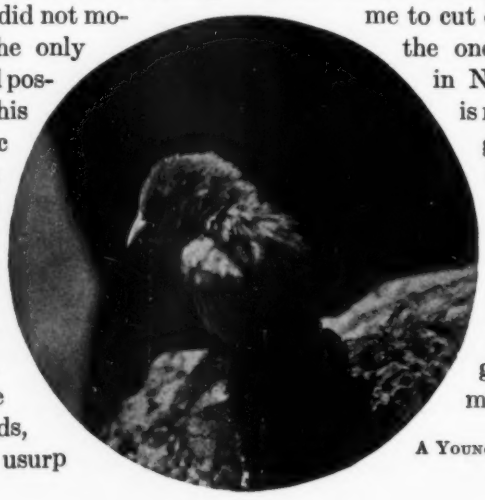
This nest became too heavy, and parts of it broke down with the supporting branches, leaving three pieces of what was once one large nest. The middle portion is about ten feet long

life of the young, or of the eggs. In fact, I found but two nests with eggs, three in one case and two in the other. In both cases the eggs were addled and broke when I tried to blow them. The eggs are very similar to those of the house sparrow, *Passer domesticus*, and are dull, dirty grayish-white, feebly speckled and marked with darker cloudy gray. Numbers of young birds were seen flying about with the adults and a few slightly younger individuals were seen being fed by the adults.

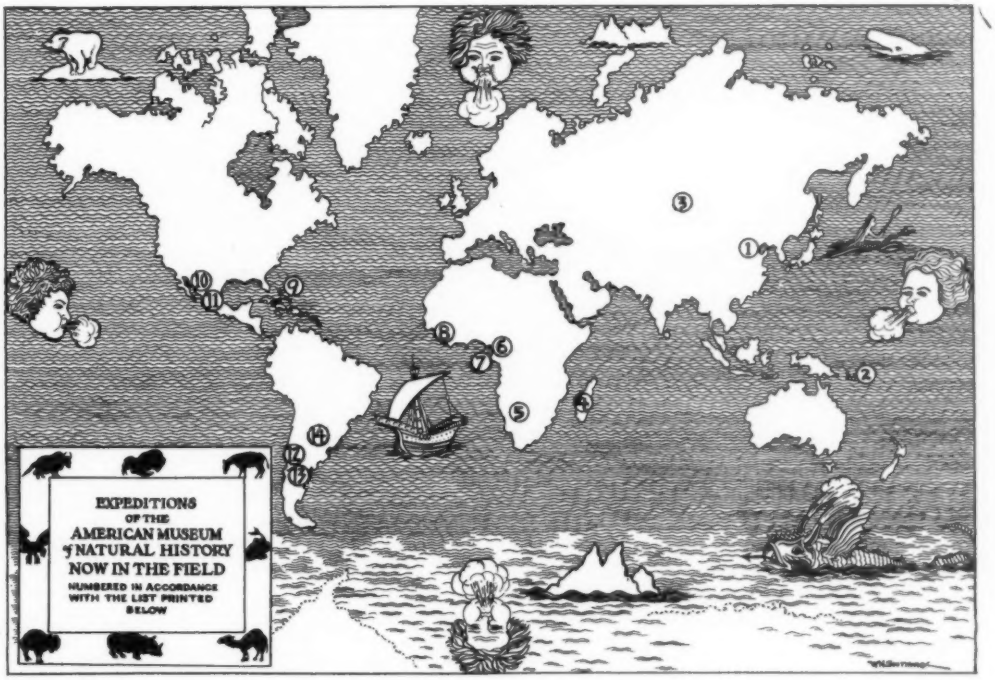
In the colonies of social weavers we find several other vertebrates living in close relations with the weavers. The pygmy falcon, *Polihierax semitorquatus*, lives in the nests with the builders, and seems to have established a most remarkable type of symbiotic relationship with them. I never saw more than a single pair of these little hawks at any one nest, no matter how large the nest was, and I never saw any sign of the slightest hostility between the weavers and the falcon. Frequently I noted both species perching side by side close together on the same branch, not more than a few feet apart, and yet in the stomachs of all the *Polihierax* I collected (three individuals) I found nothing but feathers and bird bones, but the feathers were certainly not those of *Philetairus*! It looks as though the hawk, while feeding largely on small birds, did not molest the weavers. The only good the weavers could possibly derive from this curious symbiotic arrangement is that they would be assured that any other small bird coming to their nest would not survive to usurp any breeding space there. In some nests the rose-collared love birds, *Agapornis roseicollis*, usurp an unused nest and breed in it. In such cases there seems to be no particular advantage to the weavers. I do not know of any instances of the love bird and the pygmy falcon nesting together in the same colony of social weavers. I personally never found the love bird at all, but it has been recorded by several observers as a regular breeder in these large nests.

The chief enemy of the social weaver aside from man is a tree snake or, as it is called by the Boers, "boomslang" which gets into the nests and eats the eggs and young and any adults it can catch as well. The natives are very much afraid to pass under one of the nests lest a snake drop down on them, and consequently they often set fire to the nests after they have attained considerable proportions. However, some of the nests persist for years and grow with the passing of time. The largest nest that I saw was known to some of the Boer residents for more than twenty years, and the one I collected for the American Museum of Natural History was known for at least nine years.

Because of the difficulty of transporting bulky objects, I limited my search to within five miles of the railway line. The nest collected was on the farm of Mr. James M. Lamont near Maquassi, Transvaal. Mr. Lamont prized the nests on his land, but very generously allowed me to cut down and take away the one now on exhibition in New York. When it is remembered that this gentleman has never been in the United States and has no personal interest in the public served by the American Museum, his friendly gift assumes all the more significance.



A Young Social Weaver Just Out of the Nest



1. Central Asiatic; 2. Whitney South Sea, Solomon Islands, for birds; 3. Morden-Graves, Turkestan, for mammals; 4. Madagascar, for birds, mammals, and fossils; 5. Vernay, to Africa, for mammals; 6. Columbia-University-American Museum, to Africa, for anatomical study; 7. Thorne-Correia, Gulf of Guinea, for birds; 8. Murphy, to Liberia, for birds; 9. Bacon-Miner, Bahamas, preliminary biological survey; 10. Frick-Rak, New Mexico, for fossils; Frick-Falkenbach, Nebraska, for fossils; 11. Vaillant, Valley of Mexico, archæological study; 12. Olson, South America, archæological reconnaissance; 13. Ottley-Anthony, South America, biological reconnaissance; 14. Naumburg-Kaempfer, Southeastern Brasil, for birds

AMERICAN MUSEUM EXPEDITIONS

EDITED BY A. KATHERINE BERGER

It is the purpose of this department to keep readers of NATURAL HISTORY *informed as to the latest news of Museum expeditions in the field at the time the magazine goes to press. In many instances, however, the sources of information are so distant that it is not possible to include up-to-date data*

THE COLUMBIA UNIVERSITY-AMERICAN MUSEUM ANATOMICAL EXPEDITION.—On January 21 the scientific and administrative staffs of the Museum gathered to meet Dr. William K. Gregory upon his return from the Columbia University-American Museum Anatomical Expedition to Africa. President Osborn and Director Sherwood welcomed Doctor Gregory and spoke of the interest with which the progress of the expedition had been followed, as under the able leadership of Associate Curator Raven, the members had visited the homes of the mountain gorilla, west of Lake Kivu, and of the coast gorilla in the French Cameroon.

Doctor Gregory regretted that the other members of the expedition could not be present, Mr. Raven, because he was still in the interior of the French Cameroon, Professor McGregor, on account of his duties at Columbia University, and Professor Engle, on account of illness contracted in Africa. Doctor Gregory said that the success of the expedition was due chiefly to Mr. Raven, who had worked out the long itinerary across the continent, planned the bulk of the equipment, and secured and preserved the entire bodies of the gorillas for anatomical studies in the laboratories of the Museum and of Columbia University.

Doctor Gregory said that the geological history and present geological structure of Africa, which had especially interested him, naturally had a direct bearing on the present distribution of the mammals and birds of Africa. The geologists, under the leadership of Prof. J. W. Gregory of Glasgow University, had shown that the

greater part of Africa consisted of a high plateau of excessively ancient crystalline and metamorphic rocks, which had apparently never been covered with marine formations, so that the geological succession of marine invertebrate faunas, so familiar to American and European geologists, was lacking. The upraised central portion of the plateau had in early times been eroded by rivers and had later been filled by enormous fresh-water deposits, covering the Congo Basin and containing fossil ganoid fishes, judged to be of Upper Triassic Age. The great Congo River system, however, with its hundreds of branching tributaries, apparently did not belong to this Triassic lake system but was the remnant of a far more recent enormous fresh-water lake, which, according to the evidence of the geologists, submerged a great part of the Congo Basin until perhaps after the close of the Glacial period. Then, possibly through the tilting upward of the northeastern corner of the lake bottom, the lake was drained off and the Congo River system was formed after its disappearance. Consequently the dense Congo forest, which is now the home of thousands of species of plants and animals, must have invaded that great area quite recently, perhaps only a few hundreds of thousands of years ago. At present the mountain gorilla of the Kivu region and the West Coast gorilla were separated by at least seven hundred and fifty miles of the Congo forest and for the most part by a much greater distance. They had usually been considered to be distinct species but Mr. Harold Coolidge of Harvard University, who has just completed a very carefully prepared monograph on the gorilla, has concluded that these two groups are at most only subspecies.

By what routes have the mountain gorilla and its relative the coast gorilla reached their respective ranges, which are now so far separated from each other? This would be an interesting subject for consultation with other students of the distribution of plants, animals, and birds of the Congo region, but perhaps it is significant that during the second half of the Tertiary period the group of anthropoid apes, as known chiefly from fossil jaws and teeth, ranged from Spain on the west to India on the east. Hence the gorillas and the chimpanzees, which are all rather closely related to each other, might perhaps have reached Africa from the Asiatic-European continent to the north and one section might have migrated around the north end of the Congo lake toward the west coast.

Doctor Gregory then described the experiences of members of the expedition in watching living gorillas in the field. This will be the subject of special articles in NATURAL HISTORY.

THE MORDEN-GRAVES EXPEDITION TO TURKESTAN.—The latest news comes from Mr., George Goodwin, postmarked Khabarovsk, December 14. He met Mr. George Graves at Vladivostock on December 5, after leaving Mr. Morden in Moscow. Mr. Morden expected to rejoin the expedition about the middle of January. In the meantime Mr. Goodwin has succeeded in obtaining a good series of mammals in Kazakstan under most difficult circumstances. At the time of writing, it looked as though the expedition would have to travel farther north and to the west of the Amur for tiger.

"The tigers" says Mr. Goodwin, "travel long distances and more or less follow the abundance of game, more especially the wild boar, which are in turn governed by the nut and acorn crop. This year the food for the wild boar was a complete failure and they have completely vanished somewhere, but where nobody knows—and where they are, the tigers are."

THE OTTLEY-ANTHONY SOUTH AMERICAN EXPEDITION.—A cable received the latter part of February said that the expedition was leaving Puerto Montt, Chili, for the voyage around Cape Horn.

THE BACON-MINER EXPEDITION TO THE BAHAMAS.—Dr. Roy W. Miner, curator of lower invertebrates at the American Museum, is planning to spend March and April in the Bahamas. During March the expedition will make its headquarters at Nassau, where it will be engaged upon work connected with the new coral reef group now being constructed in the Hall of Ocean Life. This part of the expedition is made possible through the generous coöperation of Mr. Daniel Bacon and Mr. Junius S. Morgan, Jr.

About April 1, Doctor Miner plans to join the International Expedition to the Bahamas conducted under the auspices of Princeton University. This expedition, under the direction of Prof. R. M. Field of Princeton University, is being supported by Mr. Hugh Matheson of Miami, who is lending his yacht, the "Marmion." The work is being carried on with the coöperation of the following:

The Percy Sladen Trust of London,
The Rouse Ball Fund of Trinity College, Cambridge,
Die Notgemeinschaft der Deutschen Wissenschaft,
The U. S. Coast and Geodetic Survey,
The American Museum of Natural History,
The Buffalo Society of Natural Sciences,
State of New Jersey Agricultural Experiment Station,
The International Summer School of Geology and Natural Resources.

The subjects of research will be undertaken by a staff of ten scientists, and studies will be made of the sponge banks on the western shore of Andros with particular reference to their geology, marine biology, bacteriology, and oceanography. Doctor Miner will coöperate with Prof. Ulric Dahlgren of Princeton on marine biological questions and with Dr. Charles Fish, director of the Buffalo Society of Natural Sciences, who has charge of the oceanographic work.

This expedition is of a preliminary character to formulate problems of a more extensive biological survey at a later time.

A RACIAL SURVEY OF THE POLYNESIAN PEOPLES.—Since March of last year Dr. Harry L. Shapiro has been in Polynesia visiting the Marquesas Islands, the Society Islands and the Tuamotus. He has just returned to the American Museum, where he is analyzing the data collected. The purpose of Doctor Shapiro's expedition was to make a racial survey to determine, if possible, the origin of the Polynesian people in relation to continental races, and also to gather material on race mixture. Much of the time Doctor Shapiro worked alone, but he visited the Tuamotus in company with Messrs. K. P. Emory and J. F. Stimson of the Bishop Museum, Honolulu. Traveling in a twenty-nine foot boat which they had built in Tahiti, they found some isolated islands where life was very primitive and therefore very interesting from an anthropological point of view.

Doctor Shapiro made a small collection of ethnological specimens and found one trephined skull. the first reported from the Tuamotus. He also discovered several groups of people of a physical type heretofore unreported from Polynesia.

THE CHARLES L. BERNHEIMER PICTOGRAPH RESEARCH EXPEDITION.—One of the most interesting mediums for the manifestations of primitive American art may be found in the innumerable engravings and paintings on rocks cliff and cave walls. A great many of these pictographs, as they are called, antedate the historic period, while others have been made more recently. Besides adding to our knowledge of primitive art, a study of these pictographs will undoubtedly reveal much information on native American life to be added to that secured through archæological excavation.

Therefore, such a study of pictographs in Southwestern United States has been undertaken by the department of anthropology at the initiative of Mr. Charles L. Bernheimer, and has been organized as the Charles L. Bernheimer Pictograph Research. The field studies were begun by Ann Axtell Morris in Cañon del Muerto, Arizona, where Mrs. Morris copied in water colors a series of compositions that were on the cañon walls. These paintings are now on exhibition in the Southwest Indian Hall, and have a chronological range from the Basket Maker period to modern Navajo.

THE ANGELO HEILPRIN EXPEDITION TO SANTO DOMINGO.—Mr. William G. Hassler has returned from Santo Domingo after a successful expedition for reptiles and amphibians. More than ten thousand specimens were collected, the lizards and their eggs alone numbering more than six thousand. The purpose of the expedition was to infiltrate reptiles in the field for exhibition purposes. Three grouplets were obtained for the Reptile Hall in the American Museum. One portrays the home life of the gecko, *Aristelleger;* a second shows the field habits of the curious tree snakes of the genus *Uromacer*, and a third illustrates the courtship antics of the giant Haitian "chameleons."

NOTES

ASTRONOMY

SOLAR ECLIPSE OF 1929 SHOWN IN MOTION PICTURES.—The first successful motion picture film of the continuous progress of an eclipse of the sun was shown to members of the Amateur Astronomers Association at their February 19 meeting when Dr. Harlan T. Stetson of Perkins Observatory gave a talk on "Eclipse Hunting." The film portrayed the eclipse from its beginning to the instant of totality, showing the solar corona, and then the gradual recession of the shadow of the moon from the disc of the sun. The presentation stirred the audience to spontaneous and prolonged applause.

The program for the final two months of the season is as follows:

April 2. Dr. Weld Arnold, F.R.A.S., "Where Are You and How Do You Know?—Navigation on Land, Sea, and Air."

April 16. Meeting postponed to the following week.

April 23. Dr. S. A. Mitchell, "One Thousand and One Stars: Their Distances."

May 7. Dr. Oswald Schlockow, "The A B C of Stars and Planets—A Talk for Beginners."

THE RADIO BROADCASTS OF THE AMATEUR ASTRONOMERS ASSOCIATION over station WOR every Saturday at 5:45 P.M. during April will be:

April 5. Dr. Clement S. Brainin. "Starshine."

" 12. Miss Jean Conklin. "How an Astronomer Finds the Distance of a Star."

April 19. Mr. C. J. Liebman, Jr. "Changing Concepts of the Solar System."

April 26. Weld Arnold, F.R.A.S. "Locating Yourself Astronomically—Navigation by Land, Sea, and Air."

CONSERVATION

THE PARC NATIONAL ALBERT.—It has been considered desirable by the Commission du Parc National Albert to organize a local committee in each of several countries to maintain liason between the central Commission and the local scientific institutions abroad. To carry out this purpose, Prince Albert deLigne, Belgian Ambassador at Washington, was asked to form the American Committee for the Parc National Albert, Belgian Congo, under his presidency. He has appointed President Osborn to serve as one of the vice-presidents of the American Committee with Dr. John C. Merriam as the other. Mrs. Mary L. Jobe Akeley has been invited to accept the post of secretary

AN APPEAL FOR CONSERVATION OF WILD LIFE IN THE BRITISH EMPIRE.—Some years ago President Henry Fairfield Osborn coined the happy phrase, "The End of the Age of Mammals." Few of those who heard him at the time realized the vast significance of the term. We all knew that the Age of Mammals was passing, but hardly grasped the imminence of the end.

In the past few decades the last vacant places of the earth have been occupied and developed with an intensity never before equalled. We had supposed that the opening up of the Far West in the last half of the Nineteenth Century was unique in its rapidity. In a few decades the Indians, the bison, the antelope and the elk, in their great herds, had marched into oblivion, but we had fondly hoped that the rich fauna of Africa, rich not only in numbers of individuals, but also surpassingly rich in the number of species, would endure indefinitely.

In November, 1929, Mr. C. W. Hobley, secretary of the Society for the Preservation of the Fauna of the British Empire, came to New York with a message of appeal from British sportsmen and British naturalists to help in the efforts of the Society to preserve what was left of the wild life within the British Empire. This would include about seventy per cent of the world's animals, and fifty per cent of these world animals are in Africa.

Everywhere the story is the same. The opening up of the country to cultivation; the fencing in of the best grazing tracts and sometimes the only available water holes; the new roads everywhere and motors in swarms to use them; the increase of population; the arming of the natives with modern weapons and, above all, the sentimental regard for the natives which encourages them to take up the only available water holes and gives them the right to slaughter for meat without restraint. The vast herds of African game move with the seasons from one grazing ground to another along the line of established water holes. If these water holes are taken up by the natives to grow a few bushels of mealies, it means the diversion of these migration routes and the death by thirst of thousands of animals. We have precisely the same experience in British Columbia, where the Stony Indians were allowed to kill game at any season and everywhere, while whites were strictly limited as to seasons and numbers. The result was that the Indians swept the country-side absolutely clear of game.

The Society for the Preservation of the Fauna has undertaken to make intensive studies as to ways and means of educating the local white settlers to conserve their game resources and to restrain improvident natives from destroying their own food supply and, above all, to secure inviolate game refuges. This last is best exemplified by the Kruger National Park, which is almost the sole hope of preserving from extermination some of the wild life in the Transvaal.

Early in January, 1930. Major Frederick R. Burnham came to New York after completing a trip around the world, during which he visited his old camps and battle grounds in South Africa, Rhodesia, and East Africa. Major Burnham reported a shocking decrease in the game everywhere and appealed to Americans to help the men on the spot to preserve their game. This purpose can best be accomplished, in the opinion of the writer, by subsidizing existing agencies for the protection of animals. For this purpose a committee has been formed and about $10,000 secured from various institutions, such as the American Museum, the Zoological Society of New York, Boone and Crockett Club, American Nature Association, Field Museum of Chicago, Wilderness Club of Philadelphia, and some individuals like Mrs. Grace Rainey Rogers in memory of her hunter brother, the late Paul Rainey.

We Americans must come to the financial assistance of those members of our race who are settling new countries and enable them to profit by our own bitter experience,—that in killing off the wild animals of the world they are destroying their best assets. Game refuges must be everywhere established and enlarged. Marketing of game, the sale of hides and horns, except for scientific and museum purposes, must everywhere be prohibited, and legislative enactments must be made *and enforced* limiting the killing of any species to the natural average annual increase in numbers. Scientific studies must be made everywhere in order to ascertain the maximum number of any species which can be maintained on a given area.—MADISON GRANT.

THE BRITISH SOCIETY FOR THE PRESERVATION OF THE FAUNA OF THE EMPIRE.—C. W. Hobley, formerly well-known geologist and explorer of Central Africa, after whom was named the *Dinotherium hobleyi*, visited the American Museum recently as acting secretary of the Society for the Preservation of the Fauna of the Empire. For the last ten years he has been engaged, through this Society, in promoting by every means the movement which is as nearly world-wide as the British Empire itself to create game preserves, to establish and enforce game laws, and to coöperate with other governments in game and forest preservation. President Osborn suggested that American coöperation would be enhanced by the formation of an American auxiliary which would assist both in propaganda and in raising funds. It was agreed that the chief causes of destruction are now economic. Mr. Hobley believes that as many as 30,000 animals are being destroyed annually for purely commercial purposes. It is estimated that between 1,500 and 3,000 elephants are being killed in Africa every year. Mr. Hobley pointed out that there would be no African and Asiatic Hall but for the efforts of his own and other societies in creating the great game preserves of Uganda, Kenya, the Sudan, and Nyasaland.

About two years ago orangs were being exported from Sumatra in such large numbers as to threaten their extinction. It was found that some of them were being smuggled over to Singapore and Penang and shipped from there without question, as they were not derived from British Territory. The Malay States Government has been directed by the Colonial Office to introduce a law prohibiting export of these animals from any port in the Federated Malay States or Straits Settlements. Apropos of this conservation movement, the Zoological Society of New York is prohibiting the purchase of young gorillas.

Due also in a great measure to the efforts of the Society for the Preservation of the Fauna of the Empire, a goodly portion of the famous Serengeti Plains in Tanganyika Territory has been declared a reserve. It was here that the murderous slaughter of lions and other animals from motor cars was being carried on.

HISTORY OF THE EARTH

FOSSILS OF THE OLDEST KNOWN PLANTS.—Mr. Lincoln Ellsworth, of Arctic fame, in a recent interview states that for the future he hopes to see commercial air lanes girdle the world via the Arctic circle. He points out that the distance from London to Hongkong is reduced one half by a short cut across the North Pole, and cites the ideal flying conditions of Arctic summers where the sun never sets for six months out of the year, and the constant summer temperature hangs around the freezing mark. Another advantage is the absence of air pockets. He says that his own interest in the Arctic is geographical exploration, although there are commercial possibilities there, when one is aware of the stability of meteorological conditions during the summer. He refers to his association with the late Roald Amundsen, which began in 1925, as being a lasting friendship, for a squarer man nor better comrade never lived. "Exploration was his work, his ambition, his calling, his recreation, his life, his death."

Mr. Ellsworth is the author of *Air Pioneering in the Arctic* and is intensely interested in navigation problems. In this connection he has assisted Lt. Commander P. V. H. Weems of the U. S. Navy in bringing out the Weems line of position book from which it is possible to determine latitude and longitude in 67 seconds. This system of simplified navigation is invaluable to navigators of the sea and air.

In recent years Mr. Ellsworth has frequently gone by plane from Coronado Beach, California, to the Grand Cañon of the Colorado River, Arizona, where he has been intensely interested in the 1927 work of Dr. David White of the U. S. Geological Survey and the National Academy of Sciences. Doctor White has obtained from the Bass limestone near the Phantom Ranch in the Bright Angel Creek Cañon four different types of fossil algæ, the oldest known plants so far discovered. Three of the forms have been called *Collenia*, *Girvanella* and *Chuaria*, the other one has not yet been identified. These fossils belong to the blue-green algæ family Cyanophyceæ.

The Bass limestone is the basal member of the Unkar division of the "Grand Cañon Series"

of rocks, which are Algonkian in age. Stratigraphically speaking, this limestone appears about 12,000 feet below the rocks of Cambrian age, the first period of geologic time to contain abundant fossils of various invertebrates. Pre-Cambrian fossils have been found at higher levels in the Grand Cañon series and elsewhere (See NATURAL HISTORY, Vol. 29, p. 334), but they are not as ancient as those found by Doctor White.

Two months ago Mr. Ellsworth was so impressed with the softly tinted "old rose" rocks of Algonkian age, near the Phantom Ranch, from which Doctor White obtained these early forms of life, that he had Gunar Wildforss, noted Swedish artist, go to the spot and paint a water color with the following inscription:

> NATIONAL ACADEMY OF SCIENCES
> FROM
> LINCOLN ELLSWORTH
> Because of his interest in the rocks (lower Algonkian) that contain fossils of the first life that have left distinct records.

—CHESTER A. REEDS.

MINERALS

POPULAR LECTURES ON GEMS.—The American Museum of Natural History has been giving a free course of popular lectures on gems and gem minerals by Mr. Herbert P. Whitlock, curator of minerals and gems, on Saturday evennings during February and March. The subject matter was "The Diamond and How It Is Polished," "Precious Stones Other Than Diamonds," "Some Semiprecious Stones," "The Quartz Gems," "The Opaque Gem Stones," "The Art of the Lapidary."

These lectures were well attended and seemed to be reaching the type of adult audience to which it was hoped they would appeal. This was apparent from the high percentage of people connected with the jewelry trade present in the audience and from the technical trend of the discussions which followed each lecture.

SCIENCE OF MAN

THE NEW LABORATORY OF ANTHROPOLOGY AT SANTA FE.—A competitive series of architects' plans for the construction of the new Museum and Laboratory of Anthropology in Santa Fe, New Mexico, is now on exhibition in the Southwest Indian Hall of the Museum. The plans are unique. Instead of being developed along the usual lines, they are excellent examples of what may be termed the new Southwestern type of architecture, which draws its inspiration largely from that of the near-by Pueblo Indians and the early Spanish conquerors.

THE BASHFORD DEAN MEMORIAL FUND

THE BASHFORD DEAN MEMORIAL FUND has recently received large gifts from Mrs. Dean and Miss Harriet Dean, Doctor Dean's wife and sister, who have constantly given their loyal support and encouragement to the department Doctor Dean founded.

Part of this fund, which was the contribution of Doctor Dean's friends and colleagues from all over the world, was used for the bronze memorial to Doctor Dean, which now stands at the entrance to the Bashford Dean Memorial Exhibit of Fossil Fishes, on the fourth floor.

The committee in charge plans to call further on the Fund for the arrangement and publication of the large and valuable collection of plates and drawings of the embryology of certain lower fishes which was left unpublished at the time of Doctor Dean's death. Dr. E. W. Gudger, and Dr. B. G. Smith of New York University, are at present working on this collection, which is to constitute a Bashford Dean Memorial Volume.

DISTINGUISHED GUESTS

THE AMERICAN MUSEUM ENTERTAINS GENERAL SMUTS.—On January 8 last President Osborn and Director Sherwood of the American Museum had the pleasure of welcoming General Jan Christian Smuts to the Museum as a guest. In company with the President and Director Sherwood he visited the more important exhibition halls and the new School Service Building. He was deeply interested also in the model of the African Hall, the details of which Mrs. Mary L. Jobe Akeley explained to him.

After the tour of inspection, General Smuts addressed the members of the scientific and administrative staffs who had assembled in the Members' Room to greet him. Turning to President Osborn, he said:

"I congratulate you on having built up something here which is distinctive, and a monument to American science, art, and adventure. The romance that lies behind all this gives me a thrill more than anything else in New York. . . . You have developed a technique that is wonderful. I hope I shall live to see accomplished the changes that are being made here. I mean to come back to see them before I die. Many years ago I met Carl Akeley, who told me about the work being done at the American Museum, but I did not believe him. You see, in meeting men with such enthusiasms as his, one sometimes takes the things they say with a pinch of salt. Yet now that I see these tremendous developments I know that he was very modest. You

have covered the history of life here. You count back 100,000,000 years and reconstruct it all, traveling down the ages, and all this is in the heart of New York."

EDUCATION

AT THE AMERICAN LEGION AVIATION SHOW held recently in New York City the American Museum was granted an exhibition space of 63×14 feet. Mr. William H. Carr, assistant curator in the Museum's department of public education, installed the exhibit, and did a very interesting and splendid piece of work. Included in the exhibition material were the two sledges used by Peary in his dash to the North Pole, and the sledge in which Amundsen reached the South Pole, also the equipment used in the dirigible "Norge" when Amundsen and Ellsworth made the memorable flight across the Polar Sea in 1926. Manikins of an Eskimo man and sledge dog in full harness showed the old method of Arctic travel. The natural history material attracted great attention, particularly from engineers and aviators, who were so deeply interested in studying the flight mechanism of the condor and the marabou stork in the exhibit, that the bird department of the Museum has been busy answering inquiries ever since. Another interesting feature was a series of insects, among which were mounted specimens of cockroaches—the first animals of any kind to fly, and dragon flies—expert fliers of the present day, whose shape somewhat resembles that of an airplane. Original paintings for NATURAL HISTORY MAGAZINE covers lent color to the exhibit.

A SECTION OF THE AMERICAN MUSEUM EXHIBIT AT THE AVIATION SHOW
The flight mechanisms with which nature equips birds, fish, and insects, was the keynote of the American Museum exhibit

TWO LECTURES ON LOCAL BIRD LIFE BY MR. MAUNSELL S. CROSBY.—Owing to the death last August of Mr. Waldron DeWitt Miller, associate curator of birds in the American Museum of Natural History, the lectures on local bird life scheduled for March 26 and April 2 in the Cultural Courses for Teachers of High Schools and Colleges, will be given by Mr. Maunsell C. Crosby of Rhinebeck, New York. Mr. Crosby is an accomplished ornithologist who has for many years made a special study of bird life inDutchess County, New York, and the Hudson Valley. He has also taken an important part as a volunteer in American Museum ornithological expeditions in tropical America.

OTHER MUSEUMS

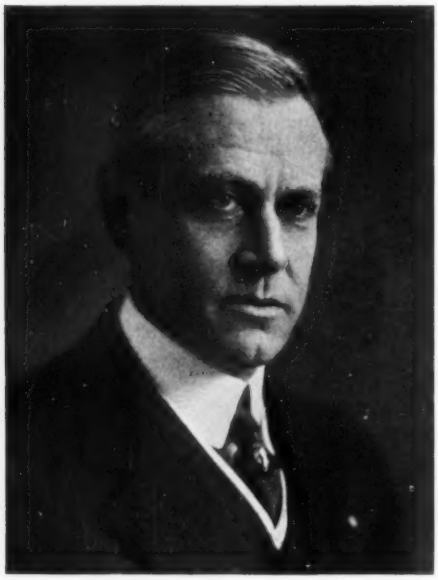
THE RESIGNATION OF DR. N. L. BRITTON.—For more than thirty-three years Dr. Nathaniel Lord Britton has served in the capacity of director-in-chief of the New York Botanical Garden. Last May, having passed his seventieth birthday, he resigned his office in order to have his time free for scientific investigation.

The scientific directors, desiring to express their recognition of his distinguished and important services to the Garden, at a special meeting appointed him Director Emeritus, and recommended the assignment of Associate Curator Percy Wilson to be his research assistant.

A record was drafted for publication in the

Journal of the New York Botanical Garden, of the services of Doctor Britton, "not alone in the inauguration and conduct of the Garden, but in the earlier years when public sentiment in New York City was being prepared to entertain and develop the idea of such an institution."

Dr. Elmer D. Merrill was appointed director-in-chief to succeed Doctor Britton.



STEPHEN TYNG MATHER
1867-1929
Former director of the National Park Service, Department of the Interior

OBITUARY

THE CAUSE OF SCENIC RESOURCE PRESERVATION suffered a great loss, when on January 22, Mr. STEPHEN TYNG MATHER, former director of the National Park Service, Department of the Interior, died in Brookline, Massachusetts. Mr. Mather had retired from his position as head of the nation's great park system because of ill health, in January, 1929. He undertook his work fifteen years ago, in the development of the national parks as the result of a letter he wrote to the Department of the Interior which came to the attention of Franklin D. Lane, secretary of the department at that time. In answer to Mr. Mather's written objections to the exploitation of the national parks system, Mr. Lane suggested that Mr. Mather come to Washington and direct them himself. Mr. Mather did. From that time on he was one of the foremost exponents of the creation of a greater system of park lands. His work was done quietly and unobtrusively, but at the time of his retirement in 1929 seven new national parks had been created under his direction: Hawaii, Lassen Volcanic, Mount McKinley, Lafayette, Grand Cañon, Zion and Bryce Cañons. Furthermore, the Shenandoah and Great Smoky Mountain parks, which he planned, have also received the approval of Congress.

In 1926 Mr. Mather was awarded the gold medal of the National Institute of Social Science for his great work in conservation.

Mr. Mather had a genius for friendship. His passing is mourned by a great host of friends, as well as by the multitude of those who did not have the privilege of knowing him personally but who did know and admire his wisdom and high devotion to the work for which he stood.

THE DEPARTMENT OF MINERALOGY OF THE AMERICAN MUSEUM suffered the loss of Dr. Lea McIlvaine Luquer, research associate in optical mineralogy, who died January 30.

Doctor Luquer was a graduate of Columbia University, School of Mines, and served his Alma Mater in the department of mineralogy for thirty-eight years.

He retired from active teaching in 1925 with the rank of associate professor of mineralogy, and was made Professor Emeritus.

Doctor Luquer was regarded as an authority on his subject, optical mineralogy, and his book, *Minerals in Rock Sections* published in 1898 is widely used as a standard text.

He was a fellow of the American Association for the Advancement of Science, and of the Mineralogical Society of America.

BOOK REVIEWS

Ends of the Earth. By Roy Chapman Andrews. With 67 illustrations from photographs. G. P. Putnam's Sons, New York and London, 1929.

IN this handsome volume Doctor Andrews has turned out a product which should prove acceptable to a wider clientele than any of his previous writings. Indeed, the reviewer is inclined to place its claims to circulation above those of any recent work of exploration known to him. This is not equivalent to saying that *Ends of the Earth* is the best book in its field, or the most important from Andrews' pen, but it is certainly the simplest, sprightliest, and, in many respects, the cleverest account of a crowded and serious, even though still short, life that has been offered to a jaded public for many a day.

The simplicity of the book is amazing. The apparent absence of "style," the seemingly naïve disregard of certain rules of composition,

might easily mislead the reader into comparing some of the writing to that of a child. But when paragraphs build themselves into pages and chapters without once letting go the interest of the most sophisticated, the artistry of plan and treatment can no longer be wholly concealed. The author is either remarkably shrewd or deeply gifted, probably both; in any case his work deserves to be bought and read.

The book is written in the manner of a straight biography, opening, after very brief introductory remarks, with the beginning of Doctor Andrews' connection with the American Museum in 1906. (The reviewer well remembers him during the early months of that period, when he had a beautiful head of hair and went singing lustily about his work—even the floor-sweeping, which may have happened once or twice!) From that fortunate day, everything has been rapid action, but despite the diversified travels with totally different objects, one feels constantly the singleness of purpose, the devotion to the institution that Andrews has represented so well, the boundless energy, the resourcefulness in making the most of opportunities.

Broadly speaking, the book may be divided into the early whaling episodes of the author's career, the cruise in the Fish Commission Steamer "Albatross" and life in Malaysia, the period of his notable studies on whales from the Japanese stations, the pioneer work in Korea, the Arctic cruise, and the long, dramatic succession of expeditions in continental Asia which have culminated in the greatest palæontological discoveries of modern times. Every incident is related without a labored phrase; no morals are pointed; you learn only by inference that the hero of this high romance has had any other aim than to enjoy himself!

Out of such a wealth of material it would be difficult to pick high spots for special citation. Doubtless each reader will have his own favorites. The delightful story of the fur seals' love affairs in Bering Sea is surely one. Life in unspoiled Japanese villages is another, and the unsuccessful tiger hunt in Korea a third. Especially appealing is the record of the old care-free, hard-riding, irresponsible, almost Olympian existence of foreigners in the Peking that is no more. All in all, one might do no better than borrow the alleged comment of Thackery about the writings of Dumas: here is a book to read from morning until evening with perfect contentment of mind.—M.

The Great Apes. A Study of Anthropoid Life. By Robert M. Yerkes and Ada W. Yerkes. New Haven, Yale University Press, 1929.

FROM the first the great apes have intrigued the imagination of man. And they are still an enigma, stooping bipeds, fleeting and illusive shadows of the human. No wonder the ancients romanced about the hairy men of the forest, even after Aristotle gave a good scientific description of the apes which begins thus: "Some animals share the properties of man and the quadrupeds, as the ape, the monkey and the baboon." In our own day there is still some romancing as to the behavior of apes, though this is gradually giving way to the application of experimental methods. In America, Professor Yerkes of Yale is justly distinguished for his exhaustive studies of the chimpanzee, and now he and Mrs. Yerkes give us a comprehensive volume dealing with all the "Great Apes," the Gibbon, the Orang-Outan, the Chimpanzee, and the Gorilla. This is not just another new book that has been added to the ever-expanding list.

Doctor and Mrs. Yerkes have given us an outstanding contribution. The illustrations are well chosen, 172 in all, with 652 pages of text, and the book, though a learned summary of what is known about these creatures, is by no means technical or dull. The first chapter opens with the history of man's early acquaintance with the apes, calling our attention to the lack of evidence that man ever tried to develop social relations with these apes or succeeded in domesticating them, the probable reason being that in some respects the apes were too near to the human and in others too distant, for though the behavior of apes is often human enough, they lack the one trait that makes all men kin, the power of speech. Not the least interesting parts of the book are those in which our authors recount the efforts of themselves and others to teach apes to talk. These, like the attempts of their predecessors, came to naught, for though the chimpanzee undoubtedly varies his cry in keeping with his emotions, he does not use words, nor does he compose them phonetically. But it is agreed that this is not because his vocal organs are not adapted to speech, but because the brain mechanism is faulty. On the other hand, we are told that the chimpanzee learns the meaning of simple words better than do other trained animals (monkeys, dogs, and horses) and that a certain kind of communication between them, the one with the other, is possible and probable. Seemingly, what the authors intend to convey is that the great apes do not acquire our speech because, for lack of the essential brain structure, they possess none of the ideas we put into words. One is tempted to add that apes do not talk because they have nothing

to say; if this is not taken too literally, it may not fall far short of the true distinction between apes and man.

However, when one turns to performance, to the things apes can do, it is far less clear that they always work differently from the ways of men, for, by pen and camera the authors show us chimpanzee and gorilla learning by experiment how to improvise step ladders by piling up boxes, poking objects out of pipes with a stick, assembling jointed rods when a longer stick is needed, etc. Some of the problems solved by laboratory apes may well astonish the reader, as the matching of colors by a chimpanzee trained by Mrs. Kohts. Unfortunately, less is known about the ability of the gorilla than of the chimpanzee; in fact, Professor Yerkes seems to have been the first to subject a gorilla to experimental tests and even then upon a single individual. Yet, meager as are these observations, it should be noted, they were made by a most experienced hand and a master of technique. Anatomists tell us that

> All things considered, the convolutional and fissural patterns of the human and the gorilla brain coincide so closely that were it not for the great disparity in size between the organs of these two species, the hemispheres of the one might be mistaken for those of the other.

So there is some ground for expecting that the gorilla will more closely simulate the human method of solving experimental problems than does the chimpanzee. Professor Yerkes, however, hesitates to rank the gorilla, though in his descriptions of the experiments the reader comes to feel that the blundering methods of the gorilla are a little more human than the jumpy, nervous methods of the chimpanzee.

In the end the reader will put down this book with a clearer understanding of the appeal the great apes have made to man, a historical perspective of what man has written about them, an insight into the accomplishments of the experimental method as applied to ape behavior, as well as many suggestive and stimulating questions as to the nature of intelligence.

—CLARK WISSLER

Le Rapport Entre le Poids et la Surface de l'Hemisphère Cérébral Chez l'Homme et les Singes. By Georges Leboucq. Bruxelles, (Lamertin), 1929.

BRAIN WEIGHT AND INTELLIGENCE.—Georges Leboucq, professor of anatomy at the University of Ghent, has recently published this most interesting paper on the relation between the weight and surface of the cerebral hemispheres of man and apes, from which we may make the following extract:

> In the series of brains which I have studied there is *a constant ratio between the weight of the hemisphere and its surface. Large brains have more surface than small ones*, in man as in woman. I have not observed any case in an adult where low weight of the encephalon was compensated by a higher ratio R, but it is not impossible that such cases exist.
>
> Being completely ignorant of the life history of my subjects, I would not venture to suggest a relationship between the morphological substratum and the psychic faculties. I only have information about two individuals:
>
> 1st. Brain No. 12 is that of Monsieur Eugène Houthoofd, aged 69 years, who in his will left his body to the Anatomical Laboratory of the University of Ghent so that he might be of use to science after his death. Monsieur Houthoofd was assistant pharmacist; he was a man of lively and original mentality. His brain was very asymmetrical, (the left hemisphere 620 gr.; the right hemisphere 606 gr.). The ratio R=2.72 for left is normal for a man of 69 years; for the right R=2.65, appreciably below the average.
>
> 2nd. Brain No. 9, of Louis H., 55 years. At the age of 20 he killed his Mother; condemned to a life sentence of hard labour, he hung himself in his cell after thirty-five years of imprisonment. The encephalon weighed 1,515 gr.; the left hemisphere 9 gr. more than the right and had an R ratio of 2.83. It would be rash to deduce from this observation that parricides have the brain of genius.
>
> Since Gall affirmed that the cerebral shell is the seat of the intellectual faculties, people have tried to find a relation between the intelligence and the quantity of cerebral matter. Great men would supposedly have a large brain. There has been testimony to confirm this hypothesis: the encephalon of Byron weighed 1,807 gr., that of Cuvier 1,829 gr., that of Tourgenieff 2,012 gr. But it is contradictory to find brains of illiterates weighing 1,800 and more. It is still more provoking to find that Gambetta had a brain of 1,246 gr. and Anatole France of 1,017 gr. The conclusion is that the weights do not prove anything and that it is only the surface which should enter into calculations. But here the data are lacking. The exterior morphology of the cerebral case of savants and artists has been examined; subtle observations and ingenious deductions have been made, occasionally reminiscent of the phrenology of the ancient Gall, but nothing has been proved.
>
> BRAIN OF ANATOLE FRANCE
>
> The latest study which has been made on this sort of material is that of Monsieur Guillaume-Louis on the brain of Anatole France.[1] This writer of genius did not have the Byronic brow and his encephalon weighed only 1,017 gr. A certain degree of senile atrophy may be taken into consideration: Anatole France was 80 years old; but assuming even the maximum diminution of 300 grams admitted by Manouvrier, a brain of 1,317 gr. would still be below the average.

The author notes on page 27 that all calculations were made on brains which had been at least fifteen days in 5% formalin, and had therefore gained about 10% in weight.

A Handbook of the Mosquitoes of North America. By Robert Matheson. Charles C. Thomas, Springfield, Ill.

HERE we have a book on the mosquitoes which should satisfy a long-felt need. The general public will find in it a great deal of interest in the chapters dealing with the habits of mosquitoes, their breeding places and the methods employed in reducing their numbers. The history of malaria and other diseases carried by mosquitoes is presented in a way which is pleasing and concise. The medical man, with a 'flare' for tracing diseases to their source will find the book invaluable, and the illustrations and thorough explanations of all

[1] Guillaume-Louis et Dubreuil-Chambardel, Le cerveau d'Anatole France. Tours, s.d.

characters used in the identification of the flies in their various stages will enable him, with a little practice, to readily determine the exact name of the creature before him. The entomologist particularly interested in mosquitoes is as well served as the others. His only objection can be that *all* the North American species are not included, but Doctor Matheson explains that he merely deals with the common species; nevertheless, there are not many omitted and a list of them is given.

The "Handbook" is beautifully printed and bound and is copiously illustrated. It is safe to say that, in its field, it is the finest thing of its kind which has yet appeared, and Doctor Matheson need offer no apologies for having omitted a few obscure and little known mosquitoes.—C. H. C.

THE OLDEST KNOWN TRUE RHINOCEROS.—The evolutionary significance of *Prohyracodon orientale* Koch has usually been overlooked. A new description and more satisfactory figures in *The American Museum Novitates* No. 395 show that it is unquestionably a true rhinoceros, and that it is correctly assigned to the Eocene, being about equivalent to Lower Bridger. Although in a stage of evolution comparable to *Trigonias* of the Lower Oligocene, it is older than any other true rhinoceros, and is only exceeded in age among rhinocerotoids by the Lower Eocene representative of *Hyrachyus*. Structurally, it is closer to American than to typical European rhinoceroses. The closest resemblances are with *Eotrigonias* and *Menina-therium*, but *Prohyracodon* is at present isolated geographically and geologically. Its progressiveness for its Eocene age suggests that the common ancestor of all rhinoceroses and near-rhinoceroses should be sought in the Lower Eocene, or even the Paleocene. A third upper molar has been obtained by the American Museum.—H. E. WOOD, II.

NEW CONTRIBUTORS TO "NATURAL HISTORY"

After completing a prolonged series of studies of the cowbirds of North and South America, **Dr. Herbert Friedmann**, now curator of birds in the U. S. National Museum, went to South and East Africa in 1924–25 to make a comparative survey of the various groups of birds with parasitic breeding habits. It was while on this trip, conducted under a grant from the National Research Council, that he made a special side trip to collect materials for an exhibition group of the sociable weaver bird for the American Museum, which he describes in his article "The Sociable Weaver Bird of South Africa."

During his many years' experience as an aquarist and collector of fishes, **Mr. L. L. Mowbray** has been connected with the New York Aquarium from 1914 to 1919, and from 1922 to 1926, and was director of the Miami Aquarium in the intervening time. Several years ago he accepted an invitation from the government of Bermuda to build an aquarium there. Under his directorship it has become one of the big attractions of Bermuda. In both the Miami and Bermuda aquariums a special feature introduced by Mr. Mowbray was the installation of living corals as group backgrounds. These he kept alive by pumping fresh salt water from the ocean to them through hard rubber pipes.

It was while on one of his collecting trips for the New York Aquarium that Mr. Mowbray had the adventure which he and Doctor Gudger describe in the article "Whale Shark!"

Capt. George Fillary Shearwood, R.A.R.O., British Army, a native of Victoria, B.C. served in East Africa from 1916 to 1920 with the King's African Rifles (4th Battalion, Uganda Protectorate). He took part in the East African campaign, serving in Kenya, Tanganyika, and Portuguese East Africa. In command of a company of 4th Bn. K.A.R. he was sent to the Kenya-Uganda Turkana Territory in 1919 to take entire charge of the Karamojo (Uganda) district. His article "Karamojo—One of Africa's Odd Corners" describes the primitive life of the natives inhabiting that area.

THE COVER

The Call to the Feast, the cover design of this issue, was painted by **Arthur A. Jansson**, and represents a scene in a village of the Manus people of the Admiralty Islands. On the veranda of his lagoon dwelling, the wealthiest man in the family of Lo is calling his relatives together for the betrothal feast of his five-year old son. In all of the forty-five houses of the village, people will cease work to listen to the drummed announcement, dividing their interest between the staccato message and the canoe in the distance which is returning from another island laden with trade valuables.

NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum, making the total number 11,946.

Endowment Member

Mr. GEO. F. BAKER, JR.

Associate Benefactors

Mrs. WALTER WEHLE NAUMBURG.

Messrs. GEORGE T. BOWDOIN, GEORGE COE GRAVES, 2D, GEORGE F. TYLER.

Patrons

Mesdames DANIEL BECKWITH, EZRA RIPLEY THAYER, CARLL TUCKER, PAYNE WHITNEY.

Messrs. W. R. COE, MYRON I. GRANGER, RALPH B. LEONARD, RICHARD C. PAINE, MORTIMER L. SCHIFF, HERBERT P. WHITLOCK.

Fellows

Mrs. WILLIAM BAMBERGER.
Mr. ARTHUR N. MILLIKEN.

Life Members

Mesdames PAUL ABBOT, JAMES FENIMORE COOPER, R. L. GERRY, CLARENCE PRICE, JOHN SLOANE.

Misses ELLA MABEL CLARK, ELIZABETH DOUGLAS.

Messrs. B. P. BOLE, CLAYTON I. CHANDLER, ALLYN COX, WATERS S. DAVIS, ALBERT DOUGLAS, ROBERT L. GERRY, GERARD C. HEGEMAN, LESLIE HERMAN, FREDERICK OSBORN, BERNON S. PRENTICE, ROSCOE W. SMITH, W. HINCKLE SMITH, ARTHUR HAYS SULZBERGER, ABEL CARY THOMAS, JAMES P. WARBURG.

Sustaining Members

Mesdames WM. H. H. BEEBE, HORACE F. POOR.

Miss ESTHER B. CUTLER.

Dr. J. BENTLEY SQUIER.

Messrs. J. O. BULKLEY, SHIRLEY C. BURDEN, THOMAS BURKHARD, RUSSELL DOUBLEDAY, W. WINANS FREEMAN, JR., OLIVER ISELIN, HENRY KRUMB, JOHN T. PRATT, JR., LEONARD HULL SMITH, S. F. VOORHEES.

Annual Members

Mesdames Fisher T. Bullard, H. S. Cullman, Geo. C. Cutler, J. Edward Davis, B. Epstein, Earle W. Fellows, Lewis F. Frissell, William S. Godfrey, Manja Kirchner, Henry F. J. Knobloch, W. Gilman Low, 3d., Wm. L. McKee, Guido Pantaleoni, Jr., Helen M. Rollinson, M. Roos, Lucie How Schelling, Nathanial Singer, John B. Stanchfield, James H. Stark, John G. M. Stone, I. Sheldon Tilney.

Misses Louise Birch, Ella Mabel Clark, Claire De Lisle, Ann Henshaw Gardiner, Doris Ann Graham, Gertrude Hill, Josaphine Ignazowski, Amelia S. Keeny, Margaret C. Kinney, F. L. Lattimore, Agnes L. Locherer, Florence Loew, Dorothy C. Lord, Gertrude Moodey, Lydia T. Morris, Marguerite E. Ross, Dorothy Schieffelin, Helen Seeley, N. M. Smith, Cornelia Weston.

Doctors Albert Bardes, Max Heiman, Howard A. Kelly, J. J. Moorhead, Van Horne Norrie, B. Pasquarelli, Dickinson W. Richards, Jr., Frederick B. Robinson, John F. Russell, James R. Scott, Howard F. Shattuck, C. R. Simboli, Robert F. Solley, Rufus E. Stetson, Holland Newton Stevenson, Wm. H Turnley.

Messrs. Arthur P. Allen, Stanley M. Babson, George Baekeland, F. P. Baeyertz, David C. Ball, Walter Beinecke, W. F. B. Berger, Robert C. Birkhahn, Vail Blydenburgh, Harold M. Brummer, John Caulfield, Richard Chadbourne, Paul S. Clapp, Francis Donaldson, Franklin Edson, 3d., Augustus H. Elliot, Harold Fields, William Flatow, Jr., Arthur W. Francis, Chas. Friedenberg, Elisha M. Friedman, R. W. Greenlaw, Edward P. Hamilton, Wallace Hamilton, Jr., Donald G. M. Hart, Waldemar Hartmann, Frederick A. Hayward, Robert G. Hooke, William White Howells, Lloyd W. Johnson, Coloman Jonas, Daniel W. Jones, Jr., Leonard Kebler, Henry F. J. Knobloch, Frank Kraft, Geo. Eliot Leighton, Edmond E. Lincoln, Clarence D. Little, Sol Livingston, E. John Long, Edward Townsend Look, J. B. Lowell, Spencer S. Marsh, Carl H. Marwig, Malcolm L. McBride, Frederick H. Meeder, Sigmund Mendelsohn, Joseph Mercadante, H. E. Merseles, Walter L. Mitchell, Lawrence Morris, Frank C. Munson, Robert C. Myles, Jr., John Burnet Nash, Walter H. Nelson, F. Maurice Newton, J. Edward Ogden, James Ogden, T. K. Peabody, Newton T. Peck, Arvid M. Pendleton Fred B. Peterson, Michael Phipps, Henry B. Plant, William T. Rasmus, Henry Renner, Philip C. Rider, Edward L. Rossiter, James Rothschild, John Rutherfurd, Alfred E. Schermerhorn, Charles R. Scott, James W. Sewell, Jr., Lesley G. Sheafer, Whitney H. Shepardson, Donald H. Sheridan, Clarence K. Simon, Ed. W. Simon, Daniel Smiley, Jr., C. Lawrence Smith, Eastman Smith, R. C. Steele, A. F. Stillman, R. W. Stovel, S. O. Styles, Herbert F. Taylor, Jr., S. Frederick Telleen, Thomas D. Thacher, David Tishman, C. P. Townsend, Arthur C. Tozzer, B. F. Tucker, Henry C. Turner, David Van Alstyne, Kiliaen Van Rensselaer, Henry Walter, Gerald F. Warburg, Philip J. Warner, William J. Weidman, C. F. Wetzel, Spier Whitaker, Charles Wiesenberg, Ernest Williams.

Masters John Low Crandall, Charles Lea Hancock, F. Woodson Hancock, 3d.

Associate Members

Prof. Hazel Ellis.

Doctors Marion D. Gamble, Gladys K. McCosh.

Mesdames E. B. Backes, Claude Bailey, H. K. Beegle, Bertha Brantley, Carleton A. Connell, G. W. Covington, Larimer A. Cushman, M. H. Davidson, Arjay Davis, H. E. Downing, George S. Elder, Elizabeth J. Esgen, Arthur Fairchild, A. Reeder Ferriday, Arthur B. Fuller, Katharine Hellwig, Isaac Hiester, Kate Hintz, Whitney Hoff, William H. Hoffman, Ava Hooks, J. L. Hooks, Alfred E. Hunt, C. R. Hurd, H. M. McGiverin, I. L. Miller, Jesse Nalle, Charles Nash, Jefferson Penn, M. Piel, H. H. Pittman, Samuel Rea, Carlton W. Rose, George D. Rumsey, D. Fitzhugh Savage, B. L. Spain, Elsie D. Stehr, William Thaw, Jr., W. Hersey Thomas, George Underwood, Jr., G. G. Wade.

Misses Jean Allen, Annette Alsop, Lorraine Barber, Jean Barker, Mary Louise Beebe, P. H. Braithwaite, A. E. Brobson, M. Emma Brookes, Elizabeth M. Clapham, Valeria S. Clymer, Dorothea Conrad, Jeanette R. Cromwell, Ann Danovsky, Rose A. Dixon, Dorothy Flinn, Ethel C. Gardner, Margaret Louise Gould, Margery K. Hayden, Margaret R. Hitchcock, Harriett Hunter, Novella McCaleb, Susan Merrow, E. D. Palmer, Doris A. Plapp, Emil Dutton Proctor, Martha Rau, Marguerite Riechers, Peggy Simpson, Ada K. Smith, Marguerite Wanger, Dalcye E. White, Anna Mary Zimmerman.

Reverend Merodach Green.

Prof. Dr. F. E. Drevermann.

Professors D. S. Hartline, Henry A. Perkins, C. H. Smith, Orma J. Smith.

Doctors M. A. Basalo, Marc Williams Bodine, Howard W. Brayton, Frank B. Cross, John L. Garretson, Geo. S. Hensyl, I. W. Kingsbury, Roy Lynde, James T. Montgomery, Sidney N. Parkinson, G. Gardner Russell, Wm. C. Schmidter, Edward A. Schumann, Forest H. Staley, Henry Tucker, John B. Wheeler, Thatcher W. Worthen.

Director Pohlhaus.

Messrs. W. Carson Adams, Geo. N. Aldredge, H. R. Aldredge, Henry M. Allen, Abd el Aziz Amer, John T. Andrews, Wm. S. Antisdale, Fred L. Avery, Robert E. Baker, Tilden Baldwin, Eric T. Bangle, R. B. Barrett, E. D. Bartlett, Charles T. Beam, Charles H. Behre, Wilfred Berry, Geo. L. Black, E. S. Bowerfind, Charles Hayes Bradley, John C. Bradbury, Louis C. Bremer, S. B. Brooks, Jr., W. B. Brooks, 3d., W. Horatio Brown, Frank H. Buck, H. R. Buck, Willard W. Burns, John H. Burnside, Ralph H. Burnside, Belton A. Burrows, Douglas S. Byers, Charles S. Campbell, James F. Campbell, S. B. Cantey, Jr., Charles Russell Carkeek, Edw. C. Carter, Geo. P. Comer, Frederick C. Copeland, Warren Currier, 3d., G. F. Deckelman, Paul de Coulon, Charles DePew, Wilbur G. Downs, R. B. Dunbar, C. A. Dunlay, Avery Ebbets, Elmer S. Ecker, Samuel C. Edmonds, W. L. Enfield, Richard Esswein, S. L. Etheridge, Robert F. Evans, Wm. C. Farrington, Clarence Faust, William L. Finley, Chas. H. Fisher, M. C. Fitz Gerald, Charles H. Fonde, Frank H. Foster, Arthur G. Frechtling, Edwin J. Frick, D. H. Fry, Paul Galster, A. W. Gardiner, D. L. Gardiner, Paul C. Gifford, O. P. Gillam, R. A. Gilliam, Charles Stuart Godfrey, Lewis Gordon, Geo. E. Graff, C. E. Green, Stephen S. Gregory, Jr., Walter Greig, Telford Groesbeck, T. S. Grubbs, Raymond G. Guernsey, R. C. Haase, C. H. Hanington, W. E. Hankins, A. T. Harding, Peter Harper, Mr. C. J. Harris, Walter W. Haviland, Robert Hays, James H. Heald, D. L. Hebard, Rufus R. Hessberg, Lord Butler Hillard, Jonathan J. Hillman, S. K. Hine, C. W. Hitchcock, Wm. F. Hoover, H. F. Hubbard, Roy S. Humbert, Jr., James Bannigan Hurley, John Ingersoll, Jr., H. Gardner Jackson-Davidson Jenks, George M. Johnson, J. Kelly Johnson, C. M. Johnston, Charles W. Jones, Burnham W. King, Emil Krauth, Gustav E. Kuchle, James F. Kurtz, Jules Labarthe, Jules Labarthe, Jr., A. Raymond Laubenstein, E. R. Leach, Everett Lee, Frank B. Long, Michael A. Mackenzie, Norman Story Mackie, Jr., Joseph Manley, Ralph L. Marvin, Alfred E. Mathieu, Charles C. B. Mayer, George P. McCallum, Norman McClintock, Wm. H. McKennan, Thomas Harrington McKittrick, Jr., Norman C. McLeod, Hiram Merritt, P. O. Miller, S. Bevan Miller, Stanley C. Mizer, Clyde B. Moore, Edward M. Moore, John Alexander Moore, J. H. Morrow, Leonard S. Mudge, Buford Myers, Jr., Albert B. Nelson, William P. Newhall, Nathan Crosby Norcross, Wm. P. Oelschlager, John Patton Ogden, David, Ogilvy, Benjamin Pagel, Frank Parmelee, Jr., F. R. Parsons, Ralph C. Patton, R. C. Paul, Samuel Pearsall, 2d., Heyward Myers Pepper, L. D Perkins, Jacob Pfeiffer, Albert Pflueger, George C. Pinkley, Matthew Pratt, John Preston, William A. Pringle, Henry Pugh, J. T. Raine, T. W. Raleigh, J. Snowdon Rhoades, John Hamilton Rice, Waldo L. Rich, George Lynde Richardson, 3d., Jeffers F. Richardson, Abbott Fuller Riehle, Harry F. Rinesmith, Wolcott Ripley, Charles D. Rissell, W. Jeff Roberson, Geo. J. Rogers, Dav. Rose, Robt. Rosenwald, Raymond Ross, Nelson Sage, William H. Sage, 3d., Wm. F. Sauer, L. G. Searl, W. E. Seel, F. M. Shoemaker, W. B. Shuler, E. Herbert Smith, Lewis Lawrence Smith, R. H. Smith, Theodore Smith, Wendell Phillips Smith, Joseph M. Steele, Edgar B. Stern, Jr., Henry Stude, W. G. Thomas, Edward Y. Townsend, Henry C. Tuttle, John C. Upham, E. J. Wagner, Charles W. Walton, H. E. Watson, W. H. Watterson, Frank M. Weaver, George F. Wetmore, Bradley Wheeler, William H. Wheeler, James G. Wilkins, Laidlaw O. Williams, Alfred Willson, Clement Wilson, Chas. W. Wolf, C. Brooke Worth, G. S. Worth, John P. Young.

Masters McCauley Howard, Preble Motley, Jr., Paul L. Stephens